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MR. PREECE ON AMERICA.

It is with no little satisfaction that we are able to say that Mr. Preece, of London, denies very positively having ever made the remark credited to him that "electricians in England have nothing to learn from America." He refers to it in some remarks, which we published last week, in concluding his very interesting description of his recent trip to the United States. Those who have attributed this remark to him, as also those who felt the injustice of it, will do well to read what Mr. Preece himself has to say about it, as also the complimentary statements which he makes. By this denial and by his honest acknowledgement of what he found to admire here, Mr. Preece has gained the respect of Americans, which they so willingly grant to the appreciative and fair-minded foreigner.

INSTITUTE POLITICS AND ITS EFFECTS.

Referring to a remarkable paper read at the late convention of the National Electric Light Association, one of the speakers, in congratulating the meeting upon having had first laid before it a paper of such great scientific and practical importance, remarked that "a year or two ago it would, undoubtedly, have first been presented to the American Institute of Electrical Engineers." A writer, in referring recently to an undignified squabble, compared it to "a family row in the A. I. E. E." In view of the course of the Institute during the last year or so, these remarks are full of significance. The character of many of the papers accepted by the latter body during that period and the petty politics by means of which some of them were foisted into the transactions, as well as other occurrences, have not had a beneficial effect on the standing of the Institute. It is to be most sincerely hoped that the coming election will place that body on a truly national and professional basis, and free it from the petty influences that have, it cannot be denied, already grievously affected its standing.

CENTRAL STATION STORAGE BATTERIES.

We have frequently called attention in our columns to the extensive employment of storage batteries in Europe in connection with electric lighting, and pointed out the advantages claimed to be derived from such use. Our central station managers have been slow to take up the subject, but recently, however, they have shown a disposition to investigate it. The discussion before the convention at Washington, an abstract of which we print elsewhere, will undoubtedly have the effect of concentrating attention on the matter, and it may not be long before we shall outstrip our European brethren in this field, as we have in others relating to electrical applications. The prevalent opinion in this country in regard to storage batteries has been largely formed with reference to those employed for traction and other purposes where light weight is a requisite, which implies a sacrifice in durability. With batteries of less plates, and yet weighing ten or more times as much as those with which we have heretofore been acquainted, it is evident that the former grounds of criticism do not apply. One of the speakers stated that he knows of no company that will not give a guarantee at least as good as 10 per cent., and another said that his firm could build a battery with a guarantee that it would last one hundred years—which statements illustrate the wide differences referred to. The advice of Mr. Salom as to the methods to be pursued pre-

liminary to deciding in regard to the introduction of the storage battery is timely, as more harm to the storage battery industry than good would be caused by the addition of this adjunct where the conditions that would render its use profitable are not present. The description by Mr. Appleton of the first station in this country to use a storage battery of American manufacture will be found not only of interest but of direct value as illustrating a case in which the conditions requisite to its profitable operation were present, and the same may be said of the remarks of Mr. Barstow. For use where a central station carries only a moderate day load, or where the current has a large maximum for a small period, there can be no doubt of the advantage to be derived from a storage battery. There are also other cases in which its use has been found profitable, and it would be well for every central station manager to make an examination of his special conditions to determine if he could not by this promising adjunct increase his dividends.

MR. SCOTT'S PAPER.

By far the most important contribution to the proceedings of the Electric Light Convention was the paper by Mr. C. F. Scott on "Polyphase Transmission," which, owing to an unfortunate delay in the cuts, we are unable to print in this issue. The paper is in two parts, the first being an admirable exposition of the principles and phenomena encountered in alternate current working. The second part, which has little or no real connection with the matter that precedes, is an account of a new polyphased current system, which was pronounced by no less an authority than Prof. Rowland to be "one of the finest inventions that has come out in recent years in this country," and as marking "an era in the science of the polyphase system." The expository portion of the paper will be a boon to the central station man, as it is written from his point of view and explains in simple terms, without the use of any mathematics, the various alternating current phenomena in regard to which a practical man desires information. The new polyphased current system described is claimed to combine the advantages of both the two and three phased systems. As shown recently in these columns, the three-phased system, to transmit a given power with a given insulation stress, requires much less copper than its two-phased rival, and Mr. Scott points out that it also has the additional advantage of less self-induction, and entails a less cost of installation in insulators and pole construction, as well as involving reduced leakage, etc., on account of having three instead of four wires, as in the other system. On the other hand, the two-phased system has the advantage of better regulation, requires a less number of transformers, and is more simple of installation. The importance of a system that contains all of the good qualities thus enumerated and discards the undesirable ones is evident, and the reader will recognize the justice of Prof. Rowland's remarks, which were to a great extent corroborated by those of Prof. Forbes. The principle involved in the system is the transformation of the phases of currents by means of converters. The currents of a two-phased generator are led to two converters, whose secondary coils are so proportioned and interconnected that the three secondary currents leading from them differ 120 degrees in phase. At the end of the transmission the currents may be used to operate three-phased apparatus, or to supply lamps, or they may be converted again into two-phased currents by means of converters similar to those at the generating station. When the loads on the different branch circuits can be balanced, there may be no material advantage in reconverting to two-phased currents, but in the reverse case, as with motor circuits, the inherent regulation of the latter system may be secured by converting again to two phases. One of the valuable points of the new system is that such unbalanced loads do not affect the balance of the transmission line nor of the station converters. Owing to the remarkable theoretical advantages the system presents, it will doubtless not be long before it is put to the crucial test of practice, and all of those interested in the progress of electrical science will heartily wish to see realized the great promise it contains.

THE ELECTRIC LIGHT CONVENTION.

The Washington meeting of the National Electric Light Association again demonstrated the usefulness of this institution and showed that it has lost little of the vigor which has been its characteristic from the beginning. While the papers read and the discussions have a sufficient value in themselves to justify the time and money expended by those in attendance, of no less value are the occasions for personal comparisons of experience and the opportunities offered by electrical manufacturers for the inspection of the latest improvements in apparatus and material. As was expected from the recent tendency toward municipal ownership of electric lighting plants, this subject occupied a prominent place at the convention. The position taken, that it is not only unjust but absolutely dishonest for municipal bodies to institute plants with no regard to the private interests thereby affected, will meet with the approval of all fair-minded men, and cannot in any sense be construed into an extreme view. This is aside from the principle of municipal ownership itself, and is rather a question whether the public should deliberately rob private citizens of the fruits of their enterprise in developing at an unknown risk a new industry. While it has been argued that the private investments in electric lighting were made with expectations of good returns, this furnishes no excuse for the confiscation of the results of years of hard work in establishing a new industry on a stable basis, but, on the contrary, its recognition would have a most blighting influence on public enterprise. The necessity of organization for the defense of the rights threatened is imperative, and the members of the Association were naturally somewhat severe in their reflections on the executives for their dereliction on this score in the past. The proposition to secure the services of an attorney in order that timely information of adverse legislation may be thereby given was eminently wise, and should lead to good results. The discussion on the subject of the most ceonomical size of arc dynamos was a timely one, and the almost unanimous opinion expressed in favor of units of 100 and even more lights for large stations will doubtless lessen the effect of the opposition that their adoption has met in certain quarters, notably at Detroit. One of the most valuable achievements of the convention was the settlement of the vexed question in regard to the rating of arc lamps. We were among the first to advocate that the rating of arc lamps should be in terms of watts, and, therefore, are especially gratified at the step taken, although we regret that the definition of a normal 1,200-c. p. arc as one produced by 300 watts was not included. As the principle, however, is now established, its application is easy of extension, and, above all, we shall hear no more of the farcical photometric measurements of arcs that brought disrepute on electrical engineering. The report of the committee on data is of more importance than seemed to be realized, as it shows that there is enormous room for improvement in the steam plants of central and power stations. It is about time that attention should be directed to the great saving that may be made in this respect, and it would be a policy of wisdom for all station managers to subject their plants to exact tests in order that they may obtain definite data showing in what directions improvements should be made. With the necessary data, it may be found that even radical changes in very many sta-

tions would be profitable through the decrease in coal consumption, and it is even possible that there may be cases in which there would be a saving by the adoption of economical machinery, even if that at present in use had to be disposed of as old metal. The discussion on the new form of arc lamp thoroughly introduced this novel device to those most interested in the subject, and the favorable account of it given by Mr. Huntly was not lost on the enterprising gentlemen composing the Association. The papers and discussions on fuses and magnetic cut-outs, metallic circuits for electric railways, central station switchboards, meters vs. flat rates, rules for safe wiring, and arc lamps on incandescent circuits, while interesting, developed nothing particularly new, with the exception of the description in the latter of a high voltage arc lamp, which promises an important addition to lighting apparatus. The striking paper of Mr. Scott and the discussion of storage batteries we reserve for separate comment.

A Current Without a Difference of Potential.

BY W. A. ANTHONY.

In an article in The Electrical World Feb. 17, 1894, in relation to "A Current Without Difference of Potential," Mr. Stern asks what direction the current would flow in the ring referred to in my note published in The Electrical World of Feb. 3. The current would flow in the direction of the E. M. F. generated in the ring by cutting the magnetic lines. If the north pole of the magnet were thrust into the ring from the observer, a current would flow counter clockwise. But there is no difference of potential in the ring, because there is no disturbance of the electrical equilibrium, no accumulation of electricity at one point at the expense of another point, no force of electrostatic attraction or repulsion, and these, and not electric currents, are the tests of electrical difference of potential.

Vineland, N. J., Feb. 26, 1894.

Refuse Utilizer.

The London "Electrician" of Feb. 16 had a number of illustrations of the boiler used in the Livet system, of which a trial is being made at Halifax, in Yorkshire; the ratio of the total useful heating surface to the grate area is said to be 50, as against 30 and 35 in the usual boilers; the so-called "coal storage" system is used, in which the refuse is mixed with coal slack in varying proportions, as occasion may require; when the load is great the proportion of coal is great, and when small no coal is used; the article states that this system has neither the elasticity nor the durability which is required, as it is not capable of dealing with long periods of idleness nor short periods of great activity, nor is it competent to cope with any large sudden change in the load, but combined with other systems of storage it might be found to answer well enough; it is stated that 13.13 pounds of water were evaporated per pound of coal in this boiler, but the results are questioned. The Lond. "Elec. Eng." in a note refers to these trials of this system, stating that the average quantity of rubbish burned per hour on each square foot of grate surface was 33 pounds, and that four separate tests showed that 4.08 pounds of water were evaporated per pound of rubbish consumed. The Lond. "Elec. Rev.," Feb. 16, also refers to these so-called tests, which its representatives witnessed and which they claim were no tests at all, and are therefore quite misleading. "Ind. and Iron," Feb. 16, also refers to this system, giving a somewhat more detailed description of the boiler and the results of some of the tests; it quotes from a circular in which it is stated that 170 h. p. per hour was obtained from the combustion of 10.17 tons of refuse in 24 hours.

Alternate Current Working.—IV.

BY HARRIS J. RYAN.

THE ordinates of the curve E_{RL}, in Fig. 11, are the sum of the corresponding ordinates of E_R and E_L. For example, the point at c on the curve E_{RL} was determined by subtracting from the ordinate $t\,d$ a length $c\,d = a\,t$. This subtraction is made because $t\,d$ is negative and $t\,a$ is positive at this particular instant t. When both values are either positive or negative their ordinates are added to form the corresponding ordinates of the resultant curve. At t the values of E_R and E_L are positive, and are equal to each other, since the two curves intersect. The ordinate for the resultant curve E_{RL}, therefore, at $t' = 2\,t'\,b = t'\,e$. A sufficient number of points at different intervals on the curve E_{RL} are thus determined to enable the curve to be located and drawn. We now come to the interesting fact that the maximum of the resistance curve E_{RL} is equal to the diagonal of the parallelogram erected on the radii that develop E_R and E_L. Fig. 11 gives graphic proof of this relation. $E_{R\,max.}$ and $E_{L\,max.}$ are the developing radii upon which the parallelogram is erected. The diagonal obtained is $E_{RL\,max.}$. Rotating this diagonal into the vertical, we find it to have a value equal to that of the maximum of the resultant curve E_{RL}. Again the angular position of this diagonal is just right for developing the curve E_{RL}. This will be found to be true upon further inspection of the diagram. Consider for a moment the values E_R, E_L and E_{RL} at the instant t''. The value of E_R at this instant equals $t''\,f$, which is equal to the developing radius $E_{R\,max.}$; the value of $E_L = 0$, equals the vertical projection of $E_{L\,max.}$, and the value of $E_{RL} = t''\,f$, the vertical projection of the diagonal $E_{RL\,max.}$ In this same manner many other points on E_{RL} may be determined by using this diagonal as a developing radius. The ordinates for the curve thus determined will be found to be equal to the algebraic sum of the corresponding ordinates of E_R and E_L. The reader should note that in using this construction the developing radii must always be separated from each other by the same angles, and that each developing radius must make one complete revolution per

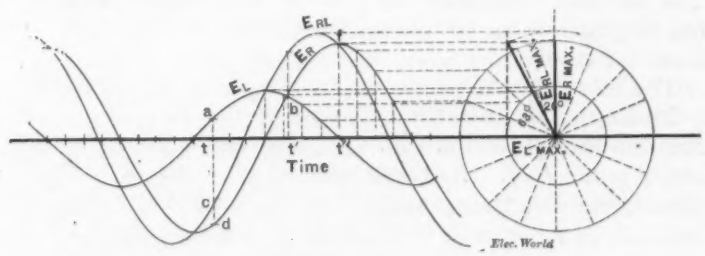


FIG. 11.

complete cycle of variation of E. M. F. or current. It is usual to use the impressed E. M. F. as the time position of reference for fixing the relative time positions of other alternating quantities connected with the same circuit. E_{RL} is the impressed E. M. F. for this circuit, the positions of the E. M. Fs. E_R and E_L are, therefore, referred to it. We see that the relative angular positions of the developing radii correspond to the relative time positions of the curves that they develop. In all these cases then where the alternating E. M. Fs. and currents may be assumed to have the form of curves of sines it is not necessary in expressing graphically values and relative time positions to plot the curves for a complete cycle or even a part of it. The developing radius

located in its proper angular position is sufficient for all purposes. Through the adoption of this method it has become customary to designate the time positions of alternating E. M. Fs. and currents by the angles between the developing radii and the developing radius of the curve of impressed E. M. F. The number of degrees in any one of these angles divided by 360, will give the corresponding fractional part of a complete period or cycle that exists between the actual curves. In Fig. 11 $E_{R\ max.}$ is 27° behind and $E_{L\ max.}$ is 63° ahead of $E_{R\ L\ max.}$, while E_L is 90° ahead of E_R. Corresponding parts of a complete period are:

$$27° = \frac{27}{360} = .075;$$

$$63° = \frac{63}{360} = .175;$$

$$90° = \frac{90}{360} = 1/4.$$

We have seen that the ratio of the $\sqrt{\text{mean}^2}$ value to the maximum value of an E. M. F., or current, is the constant for each form of curve, and that this constant is .707, generally used as .7 for sine curves. In these alternate-current diagrams one may substitute the $\sqrt{\text{mean}^2}$ values for the developing radii values, preserving, however, their angular positions. The diagonals of the parallelograms formed on the $\sqrt{\text{mean}^2}$ values will be the $\sqrt{\text{mean}^2}$ values of the resultants. This method for obtaining resultant values is usually adopted: Where a single resultant of but two values is to be determined, as is often the case, the value of the resultant is obtained by completing the triangle (see Fig. 12), for which the values producing the resultant form two sides. The line that completes this triangle has the same length as the diagonal of the parallelogram erected on the values that form the resultant.

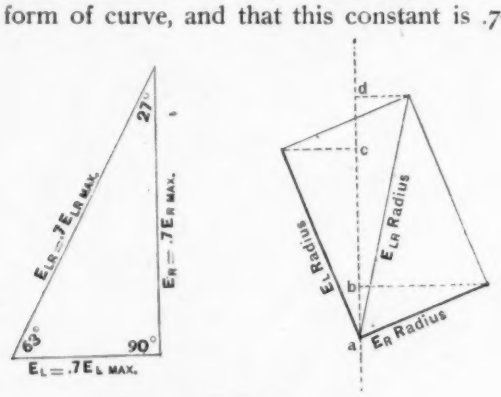


FIG. 12.

The more general proof that the diagonal of the parallelogram formed on the radii that develop the E. M. F, or current curves is found in Fig. 13. The radii are designated as E_L, E_R and $E_{R\ L}$. As these radii rotate their vertical projections develop the corresponding curves. For any particular position of these radii the vertical projections equal the instantaneous values of the corresponding curves. In Fig. 13 $a\ b$ is the vertical projection of E_R, $a\ c$ for E_L, $a\ d$ for $E_{R\ L}$. By construction $a\ b = c\ d$, therefore, $a\ d = a\ c + a\ b$, which means that the instantaneous values of the diagonal $E_{R\ L}$ equal the sum of the instantaneous values of E_R and E_L. $E_{R\ L}$ is, therefore, the true resultant.

(To be continued.)

Simple Mathematics.

A foreign contemporary facetiously calls attention to a recent article in which the author uses the word "simple," "simplified," etc., frequently, but gives equations which, in the ordinary type, are two yards long, each equation occupying two pages of the journal, and, what is worse, the equations are only approximate! It is needless to say that it was a French journal.

Photometry.

BY A. W. CLAPP.

METHODS used for comparing the intensities of sources of lights are treated of in that branch of optics called photometry, as indicated by the name. These being based on a geometrical law, no practical method has been found, up to the present time, by which mathematical accuracy can be obtained.

The difference in colors which are greatly observed in lights that are being tested gives another difficulty. In the particular case of electric lights the difference in luminous value—often very large—between the standard and the lamp to be tested still further makes the experiment more difficult, and increases the uncertainity of the test. Apart from all various methods, which have but little value, the process employed by all experts in these tests consists in replacing a direct estimate of the luminous source by an indirect comparison with a given standard. It will be seen that the test consists of substituting for a difference of luminous emission at the same distance an equal amount of light at different distances.

Kepler, the astronomer, enunciated this law, called the law of the square of distances. When a luminous source is placed successively at various distances from a screen which is illuminated the quantities of light received on this surface vary in an inverse ratio with the squares of the successive distances of the luminous source from the screen. So, if the distance is doubled, the intensity of light will be four times less; it will be nine times feebler if the distance is trebled, etc.

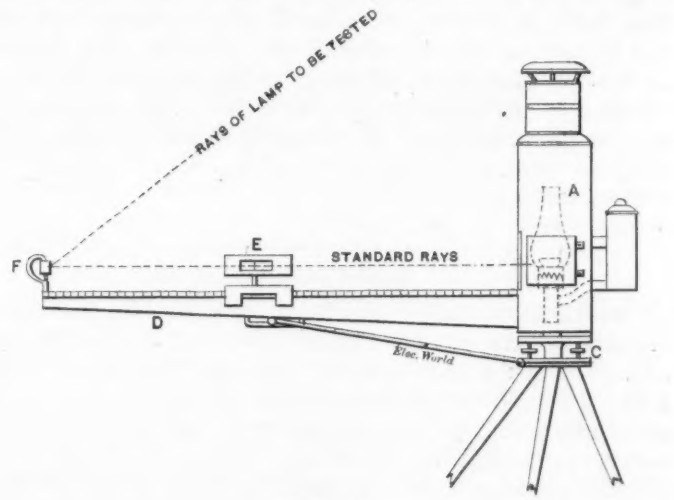


FIG. 1.

I have already said that it is very difficult for the eye to estimate the relative values in the intensities of two different luminous sources, but it can, on the other hand, judge with more accuracy when the two surfaces brought near each other are lighted equally by two sources placed at different distances and emitting their rays through the same range.

The conditions for accurate results consist in having the photometer and the eye removed from all other lights except that which is to be compared.

The photometer, such as I have been using in my tests for the government of the District of Columbia, was made by the American Meter Company, of New York, and designed especially for the particular work in view. It consists (see Fig. 1) of a standard lamp (either oil or incandescent), *A* placed upon a tripod, *C*, with leveling screws and graduated bar, *D*, which carries the box *E*. Placed at the end of this bar is a mirror, *F*, so that the

rays of the lamp to be tested may be reflected upon the screen in box, *E*. The box *E* (Fig. 2), is made of sheet metal rectangular in form, partly open at both ends. The front side has a transverse partition, *B*, dividing it into two equal parts, which partition has a large central opening closed by a semi- transparent disc, in the usual manner, the light striking upon the screen from the standard and the electric lamp being reflected to the eyes of the observer by the mirrors *A A*. The frame carrying the screen is shifted on the bar *D* (Fig. 1), until the shadows reflected on the semi-transparent disc become equal and the divisions

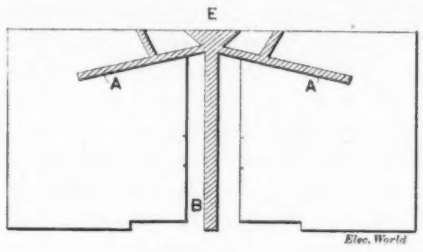


FIG. 2.

on the bar, as marked by the index on the box, is then noted, The distance of the screen from the lights is then recorded, and the ratio at the squares of the distances will give that of the intensities.

Let a lamp, *B* (Fig. 3), be hung 15 feet above the horizontal plane (photometer bar), or 20 feet above the floor; from a point directly under the lamp measure 11 feet and place the standard lamp directly over this point, thus making the mirror 15 feet from the point directly under the lamp being tested.

In observing the projection of the arc upon the screen it

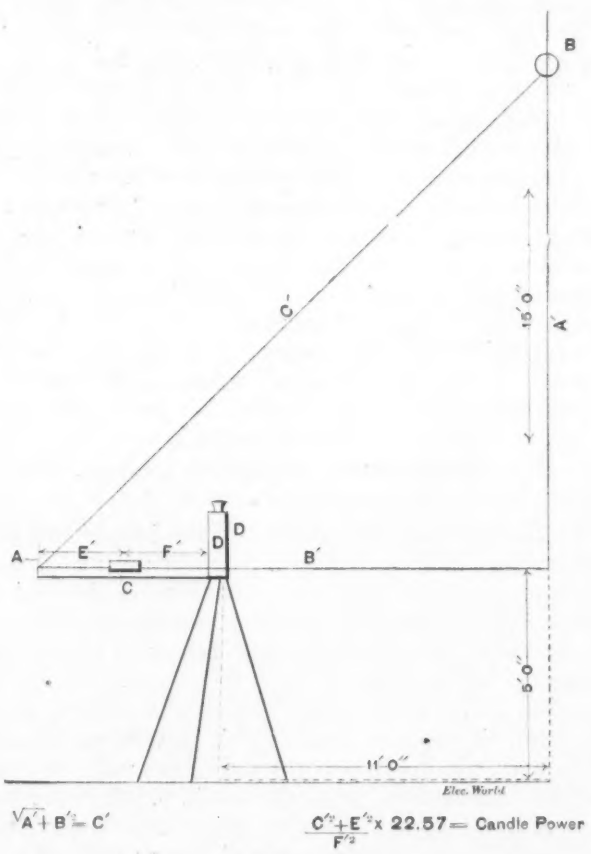


FIG. 3.

will be seen that the two carbons are not equally efficient in illuminating power. The negative carbon becomes pointed; the positive, on the contrary, is hollowed out in a crater, and of the total quantity of the light emitted about 5 per cent. only is attributable to the arc itself, 10 per cent. to the negative, and 85 per cent. to the positive.

The following rule I have used in all of my tests and experiments: The candle power of the standard lamp should be determined by direct comparison with standard candles; the electric lamps should be measured at different heights above the horizontal plane, the axis of the carbons being vertical with the positive. After each observation the lamp should be revolved 90° about its vertical axis, in one direction only, and at each reading of the photometer the E. M. F. should be taken, and the mean of ten such observations be taken in determining the candle power. Tests may be made with or without globes, as desired. The following were made with the globe in place. These tests were made at the station of the United States Electric Lighting Company, of Washington, D. C., with the assistance of Mr. Edward McCarthy, in charge of the arc lamp department. The lamps tested were of the Thomson-Houston manufacture, with clear glass globes, and known as the 2,000 nominal candle power lamps, such as are used in lighting the streets of Washington.

First test: Taken at a height of 15 feet above a horizontal plane and at an angle of 45°. The mean E. M. F. readings were 48.8 volts and a current of 10 amperes, equal to 1225.55 standard candles.

Second test: Taken as above, with an E. M. F. of 51.5 volts and a current of 10 amperes, equals 1365.22 standard candles.

Third test: Taken at an angle of 41° 38″ and 10 feet from a horizontal plane, with the following results: 47.9 volts, 10 amperes; 1090.13 standard candles.

Fourth test: This test was taken on the horizontal plane, with the following results: 49 volts, 10 amperes; 905.02 standard candles.

A Home-Made Telephone.

BY R. RADDATZ.

As the telephone question is now prominently before the public, a description of how this simple instrument may easily be made at home, with such tools as are everywhere to be found, may prove of interest to the readers of The Electrical World.

The instrument described, although simple and easily constructed, is nevertheless practical and efficient, and will transmit speech to a distance of several miles. For this purpose two instruments exactly alike are needed, one at each end of the line, but no battery or separate source of electricity is required.

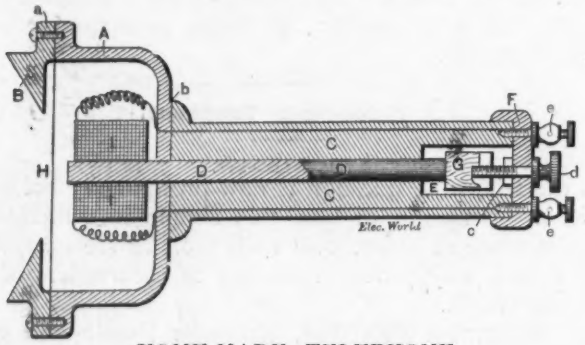
The working drawing herewith is one-half size, linear measurement, and the dimensions of any part of the instrument not mentioned in the text may be obtained therefrom by measurement. The shell of the telephone may be made of hard wood, and in case a lathe of any description whatever is at hand will offer no difficulty. In the absence of a lathe an expansive bit or a chisel and penknife will do the same work, but not so rapidly.

The resounding box, *A* in the drawing, may be made first, having a cavity 2 1-2 inches in diameter and about 1 1-8 inches deep. In making it care should be taken to have straight surfaces at *a* and *b*, so as to form square and tight joints with the parts *B* and *C*, respectively. In case this box is made with chisel or knife and turns out somewhat rough and uneven, it may be easily smoothed with a piece of sandpaper. Then the mouthpiece *B* may receive attention, the funnel, or outward part of which, is 2 5-8 inches in diameter at the widest part, and has an opening 1 1-4 inches in diameter at the bottom.

The handle *C* of the instrument may be of pine wood about 1 inch in diameter and 3 1-2 inches long, but be-

fore working upon it the permanent bar magnet *D, D,* must be obtained. This may to advantage be home made (or it may be bought), being a piece of magnetized steel 4 inches long and 1-4 inch square, or, if round, of that diameter. As the round magnet is probably most easily procurable, it was the one used in the instrument here shown. Whichever magnet is used, a corresponding tunnel must be cut or bored through the pine handle *C.* For the round form of magnet this hole is easily made with a 1-4-inch bit, while for the square form, it would be easiest to split the handle and cut a groove with a 1-4-inch chisel the full length of each half cylinder, just wide enough to allow the magnet to slide rather tightly in it. A square channel, *E,* is now cut with a 1-2-inch chisel for a distance of one inch from one end of the handle, and the two parts are glued together to form a cylinder with the tunnel, large enough to hold the magnet through it. In case of the round magnet being used and the round hole through the cylinder, it may also be found easiest to split he same and form the square channel *E,* with a 1-2-inch chisel, as in the other case, and then gluing the two halves together. The purpose of this 1-2-inch square channel *E* will be shown further on.

Next the magnet *D, D,* may receive upon one end its bobbin *I, I,* of No. 36 silk covered copper magnet wire, of which rather less than 1-2 ounce will be required for each instrument, about 6 inches of wire being left free at each end of the coil for purposes of connection. The coil should be a tight fit on the magnet, or the wire may be wound on the end of the same, putting a layer of silk over the metal



HOME-MADE TELEPHONE.

before winding with wire and when wound immersing the coil for a few moments in hot paraffine, to insure better insulation as well as to prevent the wire from absorbing moisture.

The handle *C* should now be joined to the box *A* by means of glue, and when thoroughly dry the magnet *D D,* with its bobbin *I I,* is pushed into the channel prepared for it in the handle, and the free ends of wire from the coil are run through 1-8-inch channels (made with a red hot wire) through the handle, as shown in drawing, to be afterward passed through the wooden cap *F* and placed under the small binding screws *e, e.*

But before the cap *F* is prepared a 1-2-inch square piece of hard wood, *G,* and 1-2 inch long, is to be obtained which will just fit the channel *E,* already cut for it in the handle *c, c.* Then the small thumb-screw *d* is obtained and screwed into the block *G,* so as to form a threaded channel n the block *G,* which is then fastened to the end of the magnet *D D* by means of a drop of glue and set away to dry. The cap *F* can now be made and a small hole drilled through it to receive the thumbscrew *d,* which is passed through the hole, and a wooden washer or collar, *c,* is fastened upon the screw by means of glue, care being taken that the glue does not prevent the screw from turning freely in the cap *F,* the object of the collar, *c,* being merely to prevent the screw *d* from drawing out of the cap *F* when turned.

The cap *F* can now be fastened upon the end of the handle *C C* by means of the binding post screws *e e,* under which the ends of the wires from the coil *I I* are passed, as before noted.

The screw *d* should be screwed into the block *G* as the cap *F* is drawn down by the binding post screws *e e.*

The purpose of the square recess *E* in the handle and of the block *G* glued to the magnet is now evident, as when the magnet *D D* is drawn out and in by turning the thumbscrew *d* these prevent it from turning.

In the case of the square magnet being used, this square recess is not absolutely necessary, but it is advisable to put it there for the block *G* to slide in, as this block, were it to be made of a 1-4-inch square piece of wood, would probably split apart when forcing the thumbscrew *d* into it.

The instrument being thus far completed, it only remains for us to obtain the diaphragm, shown at *H,* which is of very thin sheet iron. The "tintype" of the photographer will be found to be just what is wanted, and should be what is known to the trade as a "quarter plate," which is the smallest regular size, being 3 1-4 inches by 4 1-4 inches. This should be perfectly smooth and free from wrinkles and indentations.

When such a one is obtained the mouthpiece *B* of the telephone is laid upon it, and with a needle its exact size outside is marked upon the plate, which is then cut out with an ordinary pair of shears. The circle thus obtained is then placed between the parts *A* and *B,* and these latter fastened together with small screws, as shown. This will complete the instrument, which may then be varnished with two coats of shellac varnish (shellac dissolved in alcohol) and lamp black.

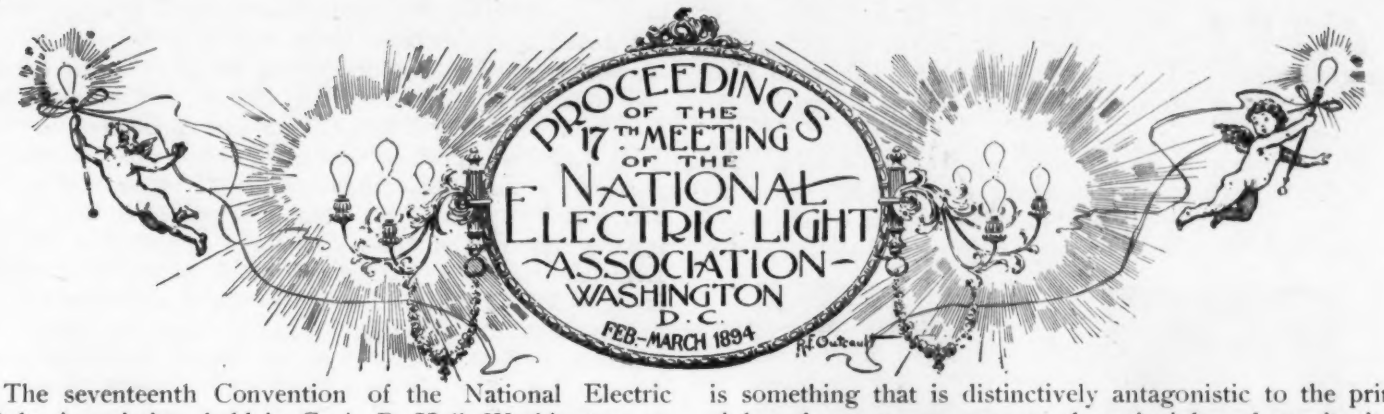
When the instrument is to be used the magnet *D D* is to be just clear of the thin iron plate *H,* which is easily effected by means of the thumbscrew *d.*

As before stated, two instruments exactly alike are necessary to carry on speech. These may be connected with two wires leading from the binding screws *e e,* or one wire being used between the telephones, with a "ground" return. If the line passes in proximity to wires carrying alternating currents it will be necessary, in order to avoid inductive effects, to use a metallic circuit—that is, two live wires instead of using the ground for the return circuit.

A "ground" may be obtained in moist earth by driving an iron rod into the latter and connecting same by wire with the telephone.

Steam Boilers for Central Stations.

In an article with the above caption in our last issue is a statement which, owing to a delay in the mails, we were unable to qualify by a note in accordance with the author's request. After stating that 5 h. p. remained in a boiler of the ordinary type for each horse power of rated capacity, the further observation is made "if a 100-h. p. boiler is run from 6 to 9 P. M., 500 h. p. will be left in it, or nearly twice as much as it has furnished." This method of comparison, is, however, not correct, as the rating is made on a basis of available horse power, while the 500 h. p. left in the boiler is the total horse power. Making this correction, the true results would be, that the amount of energy left in a boiler is about equal to the energy given out during two hours run under ordinary conditions. It would not, of course, take that amount of time to raise the pressure on a 100-h. p. boiler, as a boiler has an efficiency of almost 100 per cent. when started up cold, and it is not until the pressure has risen that the efficiency falls to its working amount.



The seventeenth Convention of the National Electric Light Association, held in G. A. R. Hall, Washington, on February 27 and 28 and March 1 and 2, 1894, was one of the most successful in the history of the Association. The attendance was large, about four hundred in number, and the general spirit of hopefulness as to an early revival of business was most noticeable and encouraging. The admirable manner in which Judge Armstrong discharged the duties of presiding officer was commented on and had much to do with the successful results achieved at the meeting, and the election of Mr. Francisco gives assurance of the continuance of the reputation enjoyed by this body for the dignified and successful manner in which its proceedings are conducted.

Owing to the attractions of the Capital City and the short journey from the homes of most of the eastern members, the Convention was brightened by the presence of an unusual number of ladies, whose attendance added a social feature most agreeable and the manifest appreciation of which again demonstrated the genial and gallant character of the electrical fraternity.

THE convention was called to order on Thursday morning at 11:07 by the president, Judge E. A. Armstrong, of Camden, N. J., who then delivered his presidential address, after which the convention was declared opened. The address of Judge Armstrong was in his usual felicitous style, and opened with a humorous allusion to all the advantages missed through the convention not being held in Philadelphia, in accordance with his personal desire, but full justice in a more serious vein was done to the attraction and merits of the Capital City. After referring to the recent business depression, the wonderful extent of the electrical industry, the great capital invested, and of its benefits to man, the feature of the address was introduced—the rapidly growing tendency toward municipal ownership of electric lighting plants.

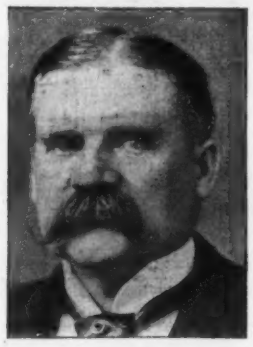
The revival of the sentiment in favor of municipal ownership is attributed largely to electrical manufacturing companies in their efforts to extend sales, a policy pronounced bad both for cities and the manufacturing concerns advocating it. An editorial from the Philadelphia "Public Ledger" was quoted, which, while pronouncing the general principle of municipal ownership to be sound, argues strongly in favor of just compensation to the electric lighting interests affected by the adoption of that policy. "I have read this editorial," continued Judge Armstrong, "because it sounds the proper sentiment: and every municipality that is honest, every government that is honest, every man that is in authority who is honest, must have due regard for every dollar that is invested in a business, whether of a corporate or private nature; and this unholy, this infamous, communistic warfare on these enterprises, not alone upon us, but upon kindred enterprises, is something that is distinctively antagonistic to the principles of our government, to the principles of our institutions and to the principles of fair minded business equity; and I tell you, whenever such principles are suffered to gain a foothold in any part of this continent, whether it affects my company or your company, whether it affects a small plant in some village or town or a big company in a large city, it strikes at the interests of all alike. If the spirit that is shown in this editorial pervaded all those who are opposing us, we would have no trouble, but we do not find this to be the case. Let us join hands in this one thing. If you have a ten

M. J. FRANCISCO. GEO. F. PORTER. C. H. WILMERDING. HON. E. A. ARMSTRONG.

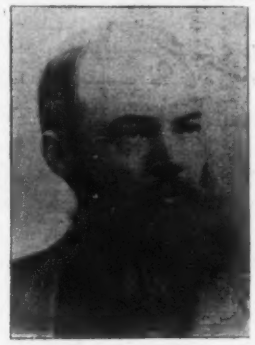
thousand dollar plant in some small village, and some one opposes you unjustly there, let us feel that it strikes the two hundred millions of dollars invested in this business in this country, and that we are behind you. As electric light men and those who have invested our money in these enterprises, if met by that spirit and with that determination, there is nothing that we can say, and if that spirit and determination is exercised, and the majority believe contrary to what we do as citizens, we must acquiesce in that decision, but we have a right to expect and to demand from our city and from our government absolutely fair treatment. As I have taken occasion before to say in our counsel, a governmental department, whether municipal, state or national, cannot afford to have anything less than a fair return; it can-

not afford to deal otherwise than strictly in accordance with that beneficent rule of conduct which mankind has named the golden rule. As soon as you lower the governmental standard, you of necessity deeper sink the individual standard of morality." (Applause.)

After referring to the prosperous condition of the association, the high character of the programme and the large attendance, attention was called to a new feature, consisting of queries from members on every subject within the province



J. FRANK MORRISON.



E. R. WEEKS.

of the association, of which he hoped full advantage would be taken, feeling sure that the answers would bring forth much information of value. After paying a graceful tribute to the ladies present, the convention was then declared opened.

A letter of regret was read from Colonel Thurber, secretary to President Cleveland, stating that owing to the absence of the President from the city, it would not be possible for him to meet the delegates. Mrs. Cleveland also regretted her inability to meet the ladies accompanying the gentlemen in attendance upon the convention.

The thanks of the association were tendered to the Metropolitan Street Railway Company for passes over its line tendered the members, and to Messrs. Bryan and Hall and the Long Distance Telephone Company for their courtesy in placing at the disposition of members the use of their system, free of charge, between the hours of 8 and 9 A. M. and 4 and 7 P. M., and to the Cosmos Club for extending the courtesies of the club house to the delegates. After reading a number of letters of regret from eminent gentlemen invited to attend the meeting of the Association, the reports of committees were called for.

Mr. C. H. Wilmerding informed the meeting that there was no report from the committee on legislation, of which he is chairman, which gave rise to a lively discussion. Mr. Huntley asked that as the committee had never done any-

C. R. HUNTLY.

JAS. I. AYER.

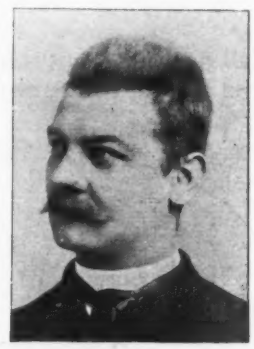
thing, it be discharged, and another means devised to accomplish the desired end. Mr. Clay offered a resolution that an attorney be employed to continuously compile a record of legislation, passed and proposed, affecting the electric lighting interests, the information to be supplied to the various members of the association in time to be of value. Mr. Insull spoke in favor of preventive action rather than retrospective discussion, and asked that the executive itself take timely action in matters affecting the association. Mr. Morrison submitted a late bill introduced before the New York Legislature, which was read, and denounced by the president as an unjustifiable attack on the rights of property. Mr. Stetson spoke of the combined action of the electric lighting interests of Massachusetts in opposing before the Legislature adverse legislation. Mr. De Camp spoke in favor of Mr. Clay's resolution, but Mr. Seeley expressed an opinion that it was the duty of the secretary to perform the functions proposed, and thus save the expense of an attorney's fee. The resolution was referred to the executive session for action.

Mr. Seeley presented the report of the Finance Committee, which showed the association to be in a flourishing financial condition.

Mr. Frederic Nicholls, chairman of the committee on relations between manufacturing and central station companies, reported the situation unchanged, and referred to the practice of electrical manufacturers in urging the establishment of municipal plants by specious arguments. The subject was referred for further discussion to the executive session.

President Armstrong introduced Dr. Gatling, the celebrated inventor and president of the American Inventors' Association, who made some interesting remarks on the industrial growth he had witnessed during his long life. He called attention to the part played by our patent system, and

A. J. DE CAMP.



T. CARPENTER SMITH.

impressed upon the meeting the necessity of guarding it, and protecting the rights of inventors. Judge Armstrong assured the speaker that the association sympathized with his ideas, and that its efforts would be always enlisted on the side of right and justice.

Mr. Hammer called the attention of the association to a recent ruling of the Postmaster General discriminating against the periodical publications of professional, scientific and other similar associations and societies, and asked that a committee of three be appointed by the president to cooperate with a similar committee of the American Institute of Electrical Engineers in laying before the Post Office Department a protest against said action and urge a request that such periodicals be again classed as second-class matter. By a unanimous vote the president was authorized to take the necessary action, and Messrs. Adams, Young and Gwinn were appointed as members of the committee.

AFTERNOON SESSION.

The report of the Committee on Data was read by Mr. H. M. Swetland, chairman, an abstract of which is given elsewhere.

In the discussion which followed Mr. Swetland stated that the average might have been lowered materially if they could have secured reports from the best stations, which

they did not. Out of the 800 answers received to inquiries sent out less than 100 were suitable for use, and the table, even as compiled, contains manifest inaccuracies. Exception was taken by some of the members to the average of seven pounds of coal per horse power, but several others stated that from their experience, particularly with the older stations, this was not excessive, and that in some cases within their knowledge it was even exceeded. The quality of coal as an important factor was referred to, and there was a concensus of opinion that in the newer stations the consumption of fuel was gotten down to four pounds per horse power, and in some instances much lower. Those joining in the discussion were Messrs. Burleigh, Nichols, Vail, De Camp, T. C. Smith, Stetson, Gwinn and Orford.

The report of the Committee on Underground Conduits and Conductors was called for, but Mr. Francisco, the chairman, explained that he thought the committee had been discharged at the Buffalo convention and therefore no report had been prepared. On motion the committee was discharged.

Copies of the report of the Committee on Rules for Safe Wiring were distributed, but the discussion was postponed until Thursday morning.

Mr. W. E. Harrington then read a paper on "Faults Incident to the Protection of Lighting and Power Circuits," an abstract of which is given elsewhere.

In the discussion Mr. White, of Evansville, Ind., said that he had used magnetic cut-outs in his station for three years with excellent results, and Mr. Robertson, of Minneapolis, stated that his experience with magnetic cut-outs was also favorable. Mr. T. C. Smith, of Philadelphia, cited instances of fuses becoming oxidized on the exterior and the interior rendered molten by the passage of an excessive current without blowing the fuse. Remarks were made by Messrs. Burleigh, Hammer, Brophy, Vail, Orford, Insull and Carnes. The general expression of opinion was that fuse wires are unreliable, and magnetic cut-outs suited only for station work.

The president introduced Prof. T. C. Mendenhall, superintendent of the Coast and Geodetic Survey, who addressed the meeting on the subject of electrical units and requested the aid of the Association, and of its members individually, in securing the passage of an act legalizing the electrical units adopted at Chicago. Upon the motion of a member, a resolution was adopted favoring the passage of the act referred to, and the Committee on Legislation was instructed to use its best efforts to further the measure.

The president recommended that a competent engineer be employed to prepare an address to the Association on "How Electricity and Electric Power are Generated and Used," in simple, untechnical language, the object being to furnish members with matter they may reprint and distribute for the information of their customers.

An invitation was read from the Rock Creek Railway Company offering free passage to members over its line, after which the meeting went into executive session.

MR. J. H. Vail read a paper on "The Importance of a Complete Metallic Circuit for Electric Railways," an abstract of which is given elsewhere. Messrs. Burleigh, T. C. Smith, Mason, Brophy, Law, Wright, Harrington and Cuttriss took part in the discussion on the paper, and on the topic next on the programme—"Electrolytic Effects of Return Currents." Before opening the discussion the president accepted on behalf of the Association, in an appreciative and gallant speech, a floral offering from "The Wives, Sisters and Sweethearts of the N. E. L. A.," which was accompanied by the following graceful address:

"To the Gentlemen Composing the National Electric Light Association: The ladies accompanying the N. E. L. A. as guests of the seventeenth convention of this body—with the same 'great diffidence' expressed by President Armstrong in his opening address—ask your acceptance of this expression of their appreciation of your courtesy extended to them in a never-to-be-forgotten national drive through the city of Washington. Kingsley has told us that 'Men must work, and women must weep.' We would modestly suggest that Kingsley had the misfortune not to be acquainted with the ladies of this Association, who could have assured him that 'Men will work, but never let women weep,' at least while guests of the N. E. L. A."

DELEGATES TO THE WASHINGTON CONVENTION.

Mr. Bracken opened the discussion on "Storage Batteries," and was followed by Messrs. Salom and Appleton. An abstract of the discussion is given elsewhere.

Mr. Huntley gave an account of a favorable experiment with the Howard incandescent arc lamp, and at his request Professor Marks explained the technical details of the lamp. The experiment extended from Feb. 4 to Feb. 23, and was on 50 lights in one circuit 11 miles long. The streets were better lighted than with the ordinary arc, and the lamps only

PROF. GEO. FORBES.

PROF. H. A. ROWLAND.

required to be trimmed once in four days. In reply to an inquiry Mr. Huntley stated that he did not go into the question of cost, but that the illumination was very satisfactory. Prof. Marks spoke of the causes of former failures to produce a lamp of the Howard type, and ascribed them to insufficient knowledge as to the carbons and glass required. He stated that by a recent improvement the negative carbon would last indefinitely, and referred to the superior distribution of light from the lamp in question, and how the problem in regard to the inclosing jacket had been solved. Messrs. Seely, De Camp, Nicholls and Burleigh also took part in the discussion.

AFTERNOON SESSION.

The discussion on the Howard lamp was continued. Mr. Howard, the inventor, stated that the rod did not require cleaning during the life of the carbon, and that a saving in carbons and trimming of 20 per cent. was guaranteed. The breakage was covered by this, and the carbons cost less than those now in use. The lamp required 61 volts and less than 500 watts. A general discussion in regard to the commercial features of the question followed, in which Messrs. Howard, De Camp, Van Trump, T. C. Smith, Stetson and others took part, the opinion being that if this part proved satisfactory the lamp had a bright future.

A PAPER by Mr. A. B. Herrick on "The Development of Switchboards for Modern Central Stations," printed elsewhere in abstract, was read and discussed by Mr. Edward Weston.

Mr. Charles F. Scott then read the paper of the convention, which, with the discussion, we will print in full in our columns. After explaining in simple terms the various phenomena connected with alternating currents, Mr. Scott introduced for the first time to the electrical public a system combining the advantages of both the two and the three phased systems. By means of specially designed converters it was shown that the currents generated by a two-phased generator could be distributed as three-phased currents and then applied directly to three-phased apparatus or again transformed to two-phased currents; by this means a three-phased system could also supply two-phased apparatus. The convention showed a lively interest in Mr. Scott's new system, and manifested its appreciation by frequent applause.

AFTERNOON SESSION.

Prof. George Forbes opened the afternoon session with a discussion of Mr. Scott's paper. He referred to the beauty and ingenuity of the method devised by Mr. Scott, which seemed to look feasible and practical. In the course of his remarks he paid a very high compliment to Mr. A. E. Kennelly, whose recent work he regarded as the most beautiful treatment of a mathematical subject yet produced. Prof. Forbes also briefly explained why the Cataract Construction Company had made no reply to the criticisms passed upon it, stating that what was wanted was work properly done, and that it is of no moment to them what opinions others may hold.

Prof. H. A. Rowland was the next speaker, and stated that he considered that this work of Mr. Scott marked a new era in polyphase transmission; he was working along a similar line himself, and while he had succeeded in finding a way to transform the frequency, as well as the phase, his method lacked the practical merits of the one under discussion.

Mr. Scott, in reply to a question of Mr. Spenser in regard to the calculation of distributed self-induction, said that the calculation would be made in parts, and after referring to several points in Prof. Forbes' address, and paying a tribute to the work of Mr. Kennelly, spoke of the great lighting plant at the World's Fair, the vast experience gained through it, and the complete success met in solving the various problems involved.

Mr. Stillwell took issue in regard to a remark of Prof. Forbes' contradicting the statement of the Westinghouse company that the system adopted at Niagara was the Tesla polyphased system, as developed by the Westinghouse technical staff, in which position he was sustained by Prof. Rowland, when the president declared the discussion closed.

Prof. Anthony presented the report of the committee on the rating of arc lamps, which was adopted. The report, after referring to the difficulty, if not impossibility, of measuring with any degree of accuracy the illuminating power of arc lamps and the great necessity of a precise definition and statement of the obligation of the producer of electricity to the consumer thereof, defines an ordinary 2,000-candle power arc lamp as one requiring on the average 450 watts for its maintenance. The measurements should be made at the lamp terminals with no sensible resistance included in series with the arc; in case there is such resistance, it must

EDWARD WESTON.

PROF. W. A. ANTHONY.

be excluded in the measurement of the voltage.

The report of the committee on the National Electric Light Association's standard rules for electrical construction and operation was then read, and after a number of changes adopted. When printed we will give a comparison of these rules with those recently adopted throughout the

country by the various underwriters' associations, which were based on the rules for safe wiring formulated by the Association at a previous meeting.

The meeting then went into executive session and the following officers were elected for the ensuing year:

President, M. J. Francisco, Rutland, Vt.
First vice president, C. H. Wilmerding, Chicago, Ill.
Second vice president, Frederic Nicholls, Toronto, Can.

NEW MEMBERS OF THE EXECUTIVE COMMITTEE.

Chas. R. Huntley, Buffalo, N. Y.
A. J. Markle, Hazleton, Pa.
W. W. Carnes, Memphis, Tenn.

Upon motion of Mr. J. I. Ayer the thanks of the Association were tendered to Mr. C. O. Baker, Jr., for the admirable manner in which he had discharged his duties as master of transportation. Thanks were also voted to Judge Armstrong, president of the Association, and to the several street railway and telephone companies which had extended courtesies to the delegates during the convention.

An invitation was read from the Georgia Electric Light Company, of Atlanta; the Mutual Light and Power Company, of Montgomery, Ala., and the Anniston (Ala.) Gas and Light Company. asking that the next meeting of the Association be held in Atlanta.

PROF. L. B. MARKS, after explaining that the Howard incandescent arc lamp, while requiring a somewhat higher voltage than the usual form, took less current and could be run at a greater efficiency than the open arc, opened the discussion on the topic "Arc Lights on Incandescent Circuits," which is given in abstract elsewhere. Those participating were Messrs. Marks, Barstow, Spencer, Andrews, Ayer, Burleigh, Nichols, Van Trump and Stetson.

The next topic, "Meters vs. Flat Rates," was opened by Mr. Frederic Nichols, who stated that most central stations using flat rates were doing so by compulsion, not being able to change without loss of customers. He spoke of the loss through the use of low efficiency lamps with flat rates, and referred to a bill recently introduced in the Canadian Parliament relegating meter disputes to government inspectors of meters. Mr. Burleigh stated that in changing from flat to meter rates one of his stations cut down the output almost one-half without materially decreasing the revenue. Mr. Carnes was in favor of meters, but Mr. Scott found that his 365 contract lights netted more than his 1,817 meter lights. Mr. Johns and Mr. Weeks both spoke in favor of meter rates. The meeting then went into executive session, at the end of which the convention was adjourned sine die.

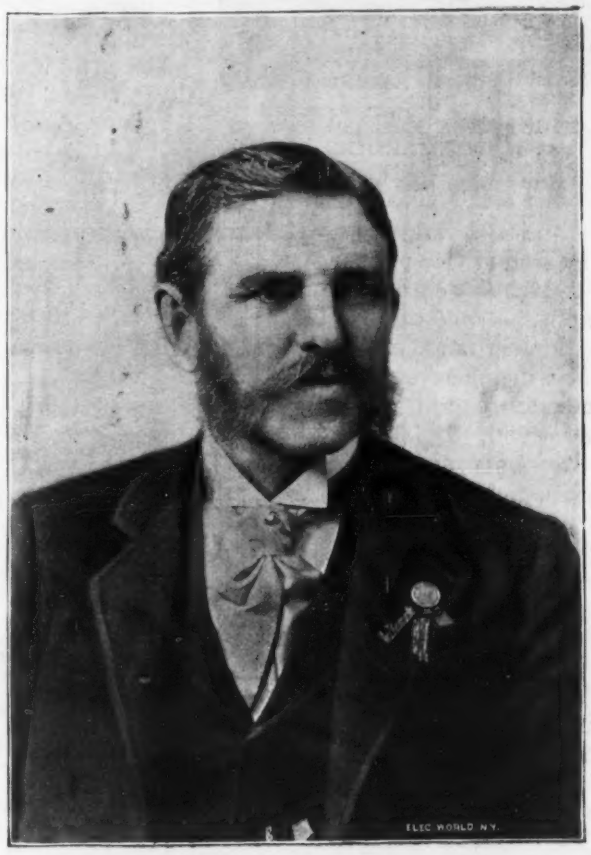
The New Officers.

PRESIDENT M. J. FRANCISCO.

M. J. Francisco, the newly elected president of the National Electric Light Association, is a Vermonter by birth and lineally descended from the men who made the Vermont shore of Lake Champlain famous during the days of the Revolution. He entered Oberlin College at an early age, and after completing his studies travelled extensively in the South and West, locating in Harrisburg, Pa., in 1867, where he established the Pennsylvania College of Trade and Finance. Over this he presided until failing health compelled him to return to Vermont, since which time he has been identified with the best interests of his native State. As manager of many of the largest English insurance companies, he has made a record second to none in New England. He entered the electric light field in 1887 as the president of the Rutland Electric Light Company, becoming a member of the National Electric Light Association in its early struggles, was made a member of the executive committee at the Kansas City convention and second vice president at Providence, being advanced to the position of first vice president at the St. Louis convention, and at the Washington convention was elected president. At the Cape May convention he read his first paper on "Municipal Ownership," which attracted widespread attention. He has contributed to many journals on this and kindred subjects.

In 1893 he published a book entitled "Municipal Ownership—Its Fallacy," which secured favorable editorial notice from the press of this country and Europe. So great was the demand that the first edition was soon exhausted, and the third edition is now in press.

Mr. Francisco's reputation, both upon electric light and insurance matters, has been such that he has been called to Washington, and before the State Legislatures of Massachusetts and Vermont, to discuss matters pertaining to these subjects. He is a member of the American Institute of Electrical Engineers.



PRESIDENT M. J. FRANCISCO.

FIRST VICE PRESIDENT C. H. WILMERDING.

The popular first vice president, Mr. C. H. Wilmerding, served last year as the second vice president. Mr. Wilmerding was born in New York City in 1858, and was educated as a boy largely abroad, in Germany and France, and afterward at the Sheffield Scientific School at Yale, where he graduated in the class of 1879 as a civil engineer. In this profession he was employed in the construction of waterworks at Troy, N. Y., and afterward went to Colorado for about two years, where he was interested in mining work in Leadville. He then entered the employ of the Rio Grande and Western Railroad, and located and constructed a considerable portion of the road between the Colorado and Utah lines and Salt Lake City. In 1884-1885 he was employed as an assistant engineer on the new Croton Aqueduct in New York City, and continued in the practice of

civil engineering until the beginning of 1888, when he turned his attention to electricity and located in Chicago. In the fall of that year he was made superintendent of the Chicago Arc Light and Power Company, and subsequently its general manager, and served in that capacity until about a year ago, when that company consolidated with the Chicago Edison company, since which time he has been in charge of the operating of the combined companies' properties. Mr. Wilmerding has always taken great interest in the National Electric Light Association, and well deserves the the honor which has been conferred upon him.

FIRST VICE PRESIDENT
C. H. WILMERDING.

SECOND VICE PRESIDENT FRED. NICHOLLS.

The second vice president, Mr. Frederic Nicholls, is one of the best known and most popular members of the Association, and his connection with the press and various commercial enterprises has brought him prominently before the public. Mr. Nicholls enjoys the distinction of being the only "foreign" officer of the Association, his home being across the border in Canada. For many years he has taken an active part in the meetings of the Association, and has been at its various meetings. He has also manifested great interest in the Canadian Electrical Association and in the Association of Edison Illuminating Companies. That he has occupied a prominent position in the business world is evidenced by the following positions which he has occupied: Second vice president and general manager of the Toronto Construction and Supply Company; director of the Incandescent Light Company of Toronto; president of the Brantford Electric Street Railway Company; general manager of the London (Ontario) lighting systems; and vice president and general manager of the Canadian General Electric Company.

SECOND VICE PRESIDENT
FREDERIC NICHOLLS.

Convention Notes.

HERE AND THERE.

The youngest attendant at the convention was Miss Mae Everett Mason, the ten-year-old daughter of General Manager Mason, of the Simplex Electrical Company, of Boston.

Brides of the convention were numerous and handsome, including Mrs. Hammer, Mrs. Sullivan, Mrs. Foster and Mrs. Issertel.

The convention brought genuine happiness to at least two of its attendants. Early in the session a pretty romance was quite completed by the betrothal of a well-known electrical man to one of the prettiest of the girls at the Ebbitt.

The convention was notable for its thoroughly business-like aspect. People attended strictly to business, and the result was that every one was satisfied.

PERSONAL.

J. H. Mason was the only representative of "Simplex" wire, but that was sufficient.

Charlie Huntley arrived Tuesday morning and was kept busy renewing old acquaintances.

Frederick A. Duggan did much to advance the fame of the Imperial Porcelain Works, of Trenton, N. J.

Isaac H. Davis carried the banner for Westinghouse, Church, Kerr & Co., and did it exceedingly well.

George G. Carter, whose name has recently come into prominence in Chicago, made a host of new friends.

J. Jones & Son, 39 Vesey St., New York City, had their interests well cared for in the hands of James Jones, Jr.

A. H. Patterson, of 42 Murray street, New York, had much to say on behalf of the Phoenix Glass Company.

George A. McKinlock was one of the notable Western men. He is East on a short trip, accompanied by his family.

C. B. Price did the honors for the Pettingell-Andrews Company, of Boston. Mr. Price knows how to do the right thing.

Frank R. Ford, for many years with the Brush-Short interests, represented the La Roche Electric Works at this convention.

F. H. Leonard, of the Dahl Electric Company, was among the early arrivals. He was likewise one of the most popular fellows present.

Henry G. Issertel, of 39-41 Cortlandt street., New York, was one of the busiest men present. He had a very neat display in the red parlor.

Ex-President Ayer came up from St. Louis somewhat behind time. As every one knows, Mr. Ayer is now in business for himself in that city.

L. K. Comstock, the well-known electrical engineer of the Monadnock Block, Chicago, was one of the youngest yet best known of the visitors from the West.

E. A. Record, special manager of the electrical department of the Vacuum Oil Company, of Boston, hustled as hard, if not a little harder, than usual.

E. Ward Wilkins was another of the solitary representatives of a great house. Every one knows that he speaks only for Partrick & Carter, of Philadelphia.

Henry C. Kellogg, Jr., kept the name of Alfred F. Moore, manufacturer of insulated wire, with headquarters at 200 North Third street, Philadelphia, among the leaders.

Frank W. Brigham, one of the busiest men at the hotel, hustled hard and did much good on behalf of the Indiana Rubber and Insulated Wire Company, of Marion, Ind.

P. H. Alexander came up from the Monumental City to renew old acquaintances. He is now an electrical engineer, with an office in the Equitable Building, Baltimore.

Dr. Charles H. Bowen, of Washington, had something of great interest in the line of insulation.

J. Holt Gates was the only representative of the Waddell-Entz Company. The opinions expressed at the convention were that this company would soon be all right.

Frank W. Harrington easily kept the name of the New York Insulated Wire Company prominent. "Jim" Godfrey was detained at Chicago on important business.

J. H. VAIL distributed a folder entitled "Facts of Interest to Electric Lighting and Railway Companies." If you failed to get a copy, address Mr. Vail at 44 Broad street, this city.

JOHN MCGHIE, the popular representative of the General Electric Company, was one of the busiest men in sight, and he was always in sight. It is doubtful if any one missed securing the neat pamphlets which he distributed.

E. H. HEINRICHS, the genial advertising agent of the Westinghouse Electric and Manufacturing Company, did his usual amount of careful, effective work for his company. Every one familiar with conventions knows the value and importance of such efforts.

FIELD DAY at the convention was the day the following gentlemen by the name of Field, who happened to meet in Washington, celebrated the occasion by a social dinner to become better acquainted: Burr K. and John M., of the Berlin Iron Bridge Company; C. J., of the Field Engineering Company, and W. A., of the local electric lighting company, of Columbus, Ohio. The Messrs. Field are not related, except by ties of friendship and of business.

"CHARLIE PRICE!" rang out in the rotunda of the Ebbitt House, in Washington, during the convention, and four men promptly answered: "Hello!" "That reminds me," remarked Mr. C. B. Price, of the Pettingell-Andrews company, blushing furiously, "of several awkward dilemmas in which I found myself at the Montreal convention, when delegate after delegate assured me that he had had the pleasure of meeting my wife; but," he added, "this convention surpasses the one at Montreal in the number of Prices." "You haven't seen Cut Price at the convention?" asked one of his auditors. "No," was the rejoinder, "but I have seen Low Price everywhere."

AMONG THE EXHIBITORS.

"AJAX" SWITCHES were kept in line by their maker, C. S. Van Nuis. Van was, as usual, very popular.

THE ABENDROTH AND ROOT water tube boilers had out a very complete line of pamphlets and literature.

THE NATIONAL WATER TUBE BOILER was represented by some neat printed matter that was well distributed.

THE BACKUS ELECTRIC CEILING AND COLUMN FANS were well represented by neat flyers, and further by R. B. Cissel.

WASHINGTON CARBONS, by a happy coincidence of names, were very prominent. J. S. Crider was their chief hustler, and he did hustle.

"CHICAGO WIRE," in white letters on a black ground, arrested the eye of all those who were looking for standard literature on insulated wires.

MUNSON BELTING had a brilliant corps of men in the persons of President A. Groetzinger, of the home office, and Colonel Shay, of Chicago.

THE SHAWHAN-THRESHER APPARATUS had an unusually enterprising corps of drummers in F. G. Bolles & Co. They distributed some very neat cards.

THE UNITED STATES MINERAL WOOL COMPANY, of 2 Cortlandt street, New York, had out an effective little card, with sample of its corrugated copper gasket.

"O. K." WIRES AND CABLES, manufactured by the Phillips Insulated Wire Company, of Pawtucket, R. I., were two letters that no one failed to observe.

SCHIEREN BELTING, whose interests were well taken care of by Charles A. Schieren, Jr., gave away scores of their "Points on Perforated Electric Belting."

THE IONA MANUFACTURING COMPANY, of Boston, by some clever movement secured the mirror space in the red parlor, where it displayed a full line of its famous specialties.

BELKNAP MOTORS were very much in evidence. Manager Brown was on hand early with a new woven wire dynamo brush that he took pride in showing to the delegates.

"THINGS ARE NOT ALWAYS WHAT THEY SEEM" is an axiom on the cover of a neat little booklet issued by the Goodrich Hard Rubber Company. This is worth writing for.

THE HOLTZER-CABOT ELECTRIC COMPANY, of Boston, was well represented by the firm of Royce & Marean, of Washington, who distributed some neat cards and dodgers.

W. R. BRIXEY must have been side-tracked somewhere, for he did not show up. "Kerite," however, was in no sense lost sight of, as it was particularly well advertised.

BONNELL'S NUBIAN SYSTEM OF SCALE PREVENTION was described in a neat booklet issued by the manufacturers of the same, the National Chemical Works, of Craigin, Ill.

A NEW MAST ARM was shown by its inventor, Thomas F. Brady, of New Britain, Conn. This, by the way, is a very clever device, and is certain to meet with popular favor.

FRANK A. THAYER, representing the Goubert Manufacturing Company, of New York, was one of the busiest men at the convention. He kept the name of his house well to the front.

MR. W. J. NEWTON, head of the firm of the Newton Electric Company, of 41 Cortlandt street, New York, was one of the youngest of the hustlers. He made many new acquaintances.

MCEWEN ENGINES had an excellent representative in the firm of F. G. Bolles & Co., general agents. They distributed some splendid literature descriptive of this well known engine.

DAVID E. EVANS & CO., of Baltimore, Md., doing a large business in construction of street railways and isolated plants, was represented by Mr. David E. Evans and Mr. G. R. Holmes.

PASS & SEYMOUR, of Syracuse, N. Y., as usual, displayed an interesting line of porcelain specialties. They were nicely located in the parlor, and were well represented by Partner Seymour.

AGENT JOHN R. COFFMAN, of the Eureka Tempered Copper Company, had some trouble getting his exhibit to Washington and in place; but he "got there," as all agreed who visited the red parlor.

THE ELECTRICAL ENGINEERING AND SUPPLY COMPANY, of Syracuse, N. Y., received many congratulation on its handsome switchboard display in the red parlor. Manager H. J. Gorke was in charge.

THE PAGE BELTING COMPANY, whose headquarters seemed to be everywhere, had an excellent representative in Geo. T. Moore. He handed out some pamphlets that every central station man present secured.

ABENDROTH & ROOT was one of the most conspicuous conspicuous names in the exhibit parlor, for under this title was displayed a remarkable amount of literature on that well known water tube boiler.

THE ROYAL ARC ELECTRIC COMPANY made a fine impression. Two of its very best lamps were burning in the rotunda of the Ebbitt House, and Louis B. Marks and J. J. Gates were hustling hard to promote its interests.

"SUNBEAM" LAMPS had an excellent representative in the person of Mr. F. S. Terry, who may justly claim to be one of the pioneers of the Association. He reports the condition of the lamp market in the West as all right.

THE FALLS RIVET AND MACHINE COMPANY sent Mr. E. L. Babcock, who has been a familiar figure at events of this kind. He reported business on the mend. Mr. C. A. Babcock was also in attendance and made many friends.

AUTOMATIC MOTOR STARTERS and rheostats, as well as a line of electric heaters, were exhibited under the auspices

of the Automatic Switch Company, of Baltimore, Md. This was one of the few operative exhibits shown.

"Paranite" stared at every one from the attractive pamphlets distributed by Manager Brigham, of the Insulated Wire Company. Whoever missed securing one of these should write the company; they are worth preserving.

The Bryant Electric Company, of Hartford, had an artistic display of their specialties. The new things shown were their arc light cut-out and 500-volt porcelain switch for railroad work, and "Bryant Switches" loomed up in good shape in the handsome red covered pamphlet distributed. Mr. Bryant was himself in attendance, and his neat exhibit won for him many compliments.

"These are our jewels" is something of a novelty in way of expressions. The Electric Appliance Company, of Chicago, used it to good effect in describing its specialties. Its interests were looked after by Mr. Frank W. Brigham.

"Have you ever heard of Paragon Pitch?" is the query with which the Meriam & Morgan Paraffine Company addressed the reader in a neat little book on its new insulating compound. This bit of literature was much in demand.

The "Ward" arc lamp, that has been prominent at al the conventions of recent years, had no need of an exhibit. Hundreds of them were in active service in the city of Washington, and Manager Corey was himself everywhere.

Gen. E. S. Greeley, head of the oldest electrical supply house in America, was in attendance. This firm has been located in Dey street, New York, for twenty-nine years consecutively. General Greeley was ably assisted by Mr. F. A. Magee.

The patriarch of the convention was Mr. Joel Sharp president of the Buckeye Engine Company, of Salem, Ohio. Mr. Sharp, though seventy years old, is bright and active. His company was one of the first to manufacture an engine for driving dynamos. Supt. G. A. Barnard was also on hand.

Agent John R. Coffman, representing the Eureka Tempered Copper Company, had a hard struggle against the carelessness of express officials and others to get his exhibit in place, but he finally got there and made a very creditable display.

The Love electric conduit system had most genial advocates in Manager A. G. Wheeler and Mr. M. D. Law. They called attention to the success of the system on the Rock Creek Railway, and many of the delegates took occasion to inspect the same before leaving Washington.

A huge "S" was conspicuous about the hotel. Every one knew that this stands for Safety insulated wire and cables. The absence of General Manager Requa was certainly to be regretted, but important business engagements prevented his coming.

"Particularly attractive" is a term that describes the ceiling fan exhibit of Diehl & Co. They showed a combination ceiling fan and electrolier, in which a group of five incandescent lamps was placed below the fan motor. It was much admired.

The Stirn Universal Electric Company had a unique operative exhibit of their "Universal pull socket" at the head of the stairs, in charge of Mr. Stirn. He lost no opportunity, and they were numerous, of telling the good points in favor of this clever device.

The Jewell Belting Company, of Hartford, a name that is familiar to every electrical and street railway man, was represented by Secretary Charles E. Newton and Charles L. Tolles. They gave away some of their souvenir bill cases that were highly appreciated.

Though not in the exhibit hall, many of the delegates had an opportunity of seeing one of the new Crocker-Wheeler motors in operation in the window of Royce & Mareaff, 1,408 Pennsylvania avenue. Dr. S. S. Wheeler was in attendance at the convention.

The Standard Underground Cable Company, of Pittsburg, Pa., was fortunate to be so well located. It was next door to headquarters. In addition to the hustling of Messrs. Marsh and Wiley, it had a neat exhibit in the red parlor, and also distributed its price list, No. XII.

Queen & Co.'s exhibit of measuring instruments was much admired, including, as it did, samples of their finest instruments. James G. Biddle and E. G. Willyoung proved themselves worthy representatives.

C-S specialties, manufactured by the Cutter Electrical and Manufacturing Company, of Philadelphia, were neatly displayed on a sample board in the exhibit hall and clearly described in its circular price list C. Every one who missed this pamphlet should write for a copy.

The famous Hart switches were represented in an attractive pamphlet issued over the name of Hart and Hegeman Manufacturing Company, of Hartford, Conn. These were widely distributed and received many compliments. Manager A. H. Pease was on hand and kept busy.

The Mosher Arc Lamp Company, of Chicago, expected up to the last moment to send one of its new and remarkable alternating lamps, but Secretary Sheriffs wired that he was detained to close a big contract for arc lamps at Sandwich, Ill. This lamp is meeting with a royal reception.

Sockets and insulators of an improved type were shown in the red parlor by the Hammond Cleat and Insulator Company, of 220 Devonshire street, Boston, Mass. Frank W. Brigham was in charge and Inventor D. J. Cartwright was with him. This line received many compliments.

The Brown telephone, well known in Washington, where many years ago it had an operating central station, advertised to the members of the convention in a new and much improved type. Major Groesbeck, of the Chicago office, was expected, but he did not arrive.

The W. S. Hill Electric Company, of Boston, displayed a complete line of its specialties in Parlor 40. President Hill was in attendance, assisted by Mr. George H. Poor. Its switches were particularly admired, while particular interest was shown in the Doane lightning arrester.

The Packard Lamp Company, of Warren, O., had, by all means, the most complete and interesting incandescent lamp display. It showed a neat string of lamps in candle powers from 5 to 500, the latter being worthy of special attention. W. D. Packard was himself in attendance.

F. P. Little Electrical Construction and Supply Company, of Buffalo, N. Y., manufacturers of the popular Kester arc lamp, made a splendid showing. Several of their handsomest lamps were on exhibition, and they gave away the most complete catalogue distributed at the convention. They were represented by Messrs. Little, Kester and Williams.

The Mather Electric Company, of Manchester, which claims to have more isolated plants in the city of Washington than any other company, was contented with the exhibit of its apparatus afforded by the lighting plant of the hotel. Vice President Thomas C. Perkins felt very proud of his display.

"Okonite" was as well as ever to the front. Its corps of representatives included Captain Candee, George T. Manson and George A. McKinlock, the latter from Chicago. These busy men found time to distribute a very handsome paper weight, representative of a section of "Okonite" cable.

The New Haven Insulated Wire Company exhibited a fan motor running 720 revolutions per minute on 110 volts, and using but 1 1-2 amperes. With this power it was capable of exhausting 7,500 cubic feet of air per minute. The motor can be wound for arc, 220 or 500 volt circuits.

McNamara Brothers, of Fairhaven, Vt., miners of slate

and marble for electrical purposes, circulated cards and literature of a character that made their name prominent. This firm has recently opened an office at 156 Liberty street, New York, and placed it in charge of George W. Zelie.

THE HENRY R. WORTHINGTON PUMPS had many an effective word spoken for them by Mr. Louis R. Alberger, of the city office. The company have perfected a system by which electrical plants do not of necessity have to be located near a river or water supply in order to obtain the benefits of condensation.

DOUBLEDAY, MITCHELL & Co. showed quick-break knife switches, which they control as manufacturers and sales agents, and also the flexible canvas jacket conduit, manufactured by the American Circular Loom Company, of which they are agents. Both excited much attention.

P. H. HOOVER, of Chicago, so long representing the P. & B. interests in that city, was present, his new card showing that he is now with the Mica Roofing Company, of 73 Maiden Lane, New York, with an office in the Boyce Building, Chicago. Hoover found a host of friends at the convention.

THE H. W. JOHNS MANUFACTURING COMPANY, whose interests were well looked after by W. F. D. Crane, gave out a handsome set of chips made from their well known insulating material. "No limit" was the assurance written on the box. They also made a very neat display of their specialties.

NOT LARGE, BUT ELOQUENT about describes the exhibit of the Interior Conduit and Insulation Company, of New York. Representative Mace was kept busy "hustling" among old customers and making new ones. He distributed to good effect an excellent number of their "Architects' Bulletin."

CHARLES E. GREGORY, from Chicago, of course, had a good deal to say for the "Climax rheostat and starting box," manufactured by McDougall, Lucas & Co. He had no other exhibit than his vocabulary and unique personality, but those seemed very effective. He also said a thing or two for the Chas. E. Gregory Company.

"P. & B.," by which letters every one knows the most famous insulating compounds, had their hard-working manager, Frank De Ronde, on the scene early. Later he was joined by President Shainwald, and together they kept the two letters of their house in the most conspicuous altitude.

THE WESTON STANDARD INSTRUMENT was particularly well exhibited. A full line was shown in the red parlor, while a particularly attractive set of pamphlets and descriptive matter was distributed. Mr. Edward Weston and Mr. Richard O. Heinrich were kept busy, and their efforts were made doubly effective by the presence of Agent Charles D. Shain.

"BRUSH APPARATUS FOR ELECTRIC LIGHTING" is a sentence that has been perhaps the foremost for the longest period since the starting of arc lighting, yet they advertised and hustled as hard as ever for business at this meeting. Manager Hamill, assisted by Brother Prentice, could be found almost anywhere.

BUCKEYE LAMPS were in charge of Representative Lean. Neat signs about the hotel announced that these lamps were burning on the hotel circuits. In addition to this, he had one of his well-known coiled filament lamps burning at the head of the stairs, and another in the red parlor. Also a fine case of samples, including a 50-volt filament and small house lamps.

THE METROPOLITAN ELECTRIC COMPANY, though not represented in person by any of its well known men, distributed some effective literature, speaking with special emphasis of P. & B., of which the company is general Western agent. The Messrs. McKinlock found it impossible at the last moment to get away on account of numerous important engagements in the West.

NEW TELEPHONES figured more than ever before in this electric light convention, on account of the expiration of the patents. The instrument of the Western Telephone Construction Company, of Chicago, had already been installed by many of those in attendance, and was most favorably mentioned. President Keelyn was expected, but was unable to be present.

THE "IDEAL" INSULATED WIRE loomed up in an ideal fashion. A coil of this wire that had been "two months in soak," was displayed in a pan of water. Current for the operation of several incandescent lamps was flowing through this immersed coil, and there was no diminution of the light. Henry C. Adams had charge of the display, and distributed some neat literature.

THE BERLIN IRON BRIDGE COMPANY had a neat exhibit of its "patent corrugated iron roofing." The interests of the company were looked after by Burr K. and John M. Field. They called attention to the fact that their new roofing had been used in the Washington station of the United States Electric Light and Power Company. Many of the delegates journeyed there to inspect it.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY, of St. Louis, was one of the most noticeable of the incandescent lamp companies. Mr. Louis Nahm had with him samples of his "American" and "Republic" lamps, and in addition gave away the neatest souvenir of the convention, in the shape of an incandescent lamp arranged as a balloon. He also distributed some neat pamphlets.

THE STIRLING COMPANY, of Chicago, makers of the celebrated Stirling water tube boiler, had out some effective literature, the title of which commences curiously with the query, "Has a Competitor Ever Advertised You?" Agent Scheffler also distributed some neat memoranda books that were greatly sought after. Secretary Stettinius was at the last moment detained at Chicago, but his interests were well taken care of.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, of New York, was one of the most prominent exhibitors. Its most interesting display was on the second floor of the Ebbitt House, where it had installed one of its handsome two-light chandeliers. This was greatly admired. The exhibit of switches in the red parlor was equally noticeable. Mr. S. A. Douglas, its representative, was particularly active at all times in saying a good word for his house.

MR. ELIAS E. RIES, president of the Ries Electric Specialty Company, of Baltimore, and representing the above company at the convention, extended a cordial invitation to all the delegates and all interested to visit the company's factory at South Gay street, Baltimore, where a line of the well known Ries sockets and switches, and also a full line of the "Ries & Scott" single phase and alternating current motors were on exhibition. He also had a neat exhibit in the red parlor.

WESTINGHOUSE INTERESTS were, as usual, well taken care of. C. Townley and Oscar H. Baldwin, of the lighting department; C. F. Scott and A. J. Wurts, of the technical corps; Messrs. C. A. Bragg, E. F. Seymour and C. B. Humphrey, of the selling department, and L. B. Stillwell, representing the company in general, were all active in their efforts to make the name of Westinghouse prominent. The company's headquarters in parlor 47 of the Ebbitt House were quite popular, and there was a big demand for its new pamphlet describing the series arc lighting system of the company.

THE CARPENTER ENAMEL RHEOSTAT COMPANY, exhibited for the first time an invention of H. Ward Leonard, which has great promise. It is an improvement in rheostats, but on

account of patents still pending, Mr. Leonard would not make public any of the important details, but stated that any device for the conversion of electricity into heat, such as soldering irons, flatirons and rheostats, can be so constructed as to be operated at a red heat or less temperature without any destructive effect. Under this principle a No. 18 B. & S. German silver wire has been made to carry a current of 80 amperes instead of 4 amperes, which would be its full current capacity if exposed to the air as usual. Both Mr. Leonard and Mr. Carpenter were present.

General Electric Company, while making no special display of the improved apparatus it has recently perfected and brought out, brought down the first few of the new Thomson '93 arc lamps for incandescent and railway circuits. These were suspended in front of its Washington agency, opposite headquarters. Examination of the lamp mechanism showed its marked superiority from the point of view of simplicity. These lamps formed the centre of an admiring crowd of arc light station men. In addition, the new arc and railway watt meters were shown. These have only very recently been perfected, to meet what had become a crying necessity. Their practical operation showed a precision and perfection equal to that of their well-known recording watt meters for incandescent circuits. The General Electric Company was well represented by the following gentlemen: S. Dana Greene, A. D. Page, C. B. Davis, F. C. Todd, W. S. Howell, T. Beran, John McGhie, A. B. Herrick, and one or two others. They were all warmly welcomed by their old friends, the central station men, and from their busy appearance, seemed to be laying the foundation for much future business. Mr. Herrick's paper on switchboards and switchboard work was one of the attractions of the convention, and illustrated with numerous views projected on a screen.

Faults Incident to the Protection of Lighting and Power Circuits.

Mr. W. E. Harrington read a paper with the above caption, of which he and Mr. L. S. Stanley were joint authors, calling attention to the various causes affecting the reliability of fuses and magnetic cut-outs. The defects in fuses are enumerated as follows:

1. Lack of uniformity in proportioning and mixing the constituent alloys of the fuse; also in the methods of drawing the wire to a uniform geometric cross-section,and in preparing the fuse for the market. 2. Lack of uniformity, in practice, in the actual placing of the fuse in the following particulars: *a*. Length of fuse for a given service. *b*. Mass of the terminals used. *c*. Position of fuse as to whether it be vertical or horizontal. *d*. Environment, whether it be held in suspension, between terminals, or is allowed to lie along its entire length upon a mass of heat radiating material, and whether it be open to the air or enclosed in a chamber. 3. Deterioration caused by—*a*. Recurring abnormal currents. *b*. Oxidation from various causes. *c*. Disintegration from local voltaic action. 4. Impairment of contact at terminals due to loosening of the clamps from temperature expansions and contractions, or to mechanical or electrical causes. 5. The "Peltier" effect. 6. The abuse of acceptable fusing devices, by substituting for the metals designed to be used in them others that are unsuitable. 7. Time element. Practice has demonstrated that fuses rarely, if ever, "blow" in time to accomplish the object for which they are placed in circuit. There is also a wide range of uncertainty as to the constancy of this period of time for any given fuse. 8. Capacity of the ordinary fuse wire to pass current far in excess of its rated blowing capacity for a period of time sufficient, in a majority of cases, to cause damage to some portion of the circuit. The conclusion of the authors is that the fuse wire cut-out is not only an absolute failure, but actually dangerous.

Magnetic cut-outs are divided into two classes: first, a long throw knife-blade switch operated to open by a trip actuated by the armature of an electromagnet, and, second, a device for preventing or for blowing out the arc formed at the switch jaws by the breaking of the circuit. The principal point of difference in any two magnetic cut-outs of the present day is the methods adopted to overcome the destructive effect of the arc, which are the auxiliary break method and the electromagnetic blow-out method. Of these the first is criticised on account of the carbon plates or pencils employed, which are not only fragile and quickly destroyed by an abnormal current, but generate a highly conductive gas, which may not only cause damage in the circuit in which it is evolved, but also to neighboring circuits on the switchboard. Besides, the auxiliary circuit is not competent to carry its proportion of an abnormal current, with the consequence that both the bridge and switch plates may be fused before the circuit is opened. Other defects are pointed out, but the conclusion is reached that, with all of their faults, magnetic cut-outs are superior to fuses.

A magnetic cut-out which would exhibit a long stride toward ultimate perfection would be a switch operated to open by the direct action of a magnet upon the switch bar in such a manner as to cause the current itself to drive the bridge away from the switch plates, thus insuring the quickest possible response to an abnormal current. The break at the switch terminals should be protected by a by-path or shunt across the switch terminals, composed of a fuse wire of a carrying capacity sufficient to carry the current for a period of time ample to allow the switch bridge to reach a point of safety, and of a fusing capacity that will cause it to "blow" instantly when the switch bridge has thus reached a point of safety. The magnetic circuit should be so arranged that the point of saturation would be beyond the capabilities of the flux incident to the opening of the switch upon the passage of a current at which it might be set and expected to open. Consequently, when abnormal currents, in excess of that at which the switch was set to open, occurred, the result would be an acceleration of movement of the plunger up to the point of saturation, and the time element would thus be reduced to a minimum.

Coal Consumption in Generating Electricity.

The committee on data of the National Electric Light Association, consisting of H. M. Swetland, T. Carpenter Smith, E. F. Peck, G. G. H. Blaxter and C. E. Scott, presented the following table as the result of their efforts to procure data on the consumption of coal in generating electricity. The report calls attention to the fact that the results do not compare favorably with those secured in generating power for manufacturing purposes, and point out the superior economy obtained with large units running continuously. In order to facilitate comparisons, a table has been prepared on the basis of 90 per cent. mechanical engine efficiency and with the same efficiency for the dynamo, as follows:

Coal per hour per I. H. P.	Watt-hours per lb. of coal.
1.5 lbs. should produce	402.84
2 " " "	302.13
3 " " "	201.42
4 " " "	151.06
5 " " "	120.85
6 " " "	100.71
7 " " "	86.32
8 " " "	75.53
9 " " "	67.14
10 " " "	60.43
11 " " "	54.93
12 " " "	50.35
15 " " "	40.28
18 " " "	33.57
20 " " "	30.22

TABULATED STATEMENT OF DATA.

(Where there are blanks in the table, details were not given.)

Hours.	Amperes.	Volts.	Watt-hours.	Pounds Coal.	Kind.	Watt-hours per lb. coal.
24	583	115	1,609,070	10,800	slack	150
15½	101	120	187,860	2,940	.....	64
14	....	.....	386,385	3.755	slack	103
.....	....	....	10,989,870	64,155	slack	171
6	25 inc. / 18 arc.	1,000 / 1,500	312,000	4,200	.....	72
6	800 inc. / 6.8	52 / 2,750	361,800	8,000	slack	45
9½	200	1,100	2,090,000	39,750	Ind. block	53
24 / 22	10 / 879½	117 / 1,180	259,600	16,420	Ind. block	166
7	4¼	2,000	59,500	2,000	soft	30
10	225	110	247,500	4,400	slack	56
14½ / 7	20 / 6.8	1,046 / 1,632	381,023	7,300	soft	52
6	7	2,640	110,880	1,000	pea	110
14.6	....	....	315,360	6,930	slack	46
6.5	....	....	401,249	5,469	slack	73
24 / 8¾ / 24	39 / 9.6 / 296	1,050 / 2,068 / 500	982,800 / 172,058 / 355,200	30,852	slack	42
15	150	120	270,000	5,925	slack	46
13 / 10	400 / 10	113 / 810	587,600 / 81,000	7,000	Pekay	95
6	300 / 10	120 / 1,050	279 000	4,000	.....	70
8	19	1,000	152,000	1,404	slack	108
8 / 7	113⅛ / 0¾	110 / 560	99,550 / 26,460	1,584	.....	79
24	4,409	122.1	12,920,136	70,352	screenings	183
inc. 24 / arc. 24 / pwr. 24	84 / 80 / 145	1,100 / 2,000 / 550	2,217,600 / 3,840,000 / 1,914,000	38,220	hard sc'gs	208
.....	200 inc. / 24 arc. / .. pwr.	125 / 1,550 /	375,000 / 421,600 / 46,000	7,942	Cumberland and sc'gs	106
15 / 4	234 / 6.8	50 / 500	189,100	6,000	.....	31½
7 / 12⅔	285 / 268	54¼ / 52	283,820	5,450	Ptbg. nut and slack	52
inc. 24 / pwr. 18 / arc. ..	369 / 80 /	110 / 500 /	974,160 / 586,740 / 720,000	12,267	soft	186
6	200 inc. / 10 arc.	110 inc. / 50 arc.	132,000 / 3,000	2,000	bit. slack	67
6	141	108	91,368	1,400	Lehigh pea buckwheat	65
14½	26	1,000	377,000	4,200		90
15 inc. / 18 pwr.	108 / 65	1,135 / 525	1,838,700 / 614,250	18,600	.....	132
15	60	1,100	990,000	8,960	ant. bkwt.	110
inc. 11 / arc. 5½	20 / 9½	1,000 / 1,000	272,250	3,257	Ygy. lump	83
12	28	1,000	336,000	3,500	Pardee soft	96
inc. 13 / arc. 11	400 / 9½	52 / 2,700	552,550	6,000	ant. bkwt.	92
16	46	1,070	787,520	6,500	bituminous	121
pwr. 12 / inc. 24	160 / 775	203 / 132	389,760 / 2,455,200	27,366	Y'ghiogheny	104
inc. 8 / arc. 7	240 / 8½	110 / 1,375	211,200 / 81,812	3,000	bituminous	98
inc. 15½ / arc. 6	230 / 8	104 / 45	370,760 / 2,160	3,360	slack and nut	111
inc. 15½ / arc. 13	15 / 10	52 / 4,050	12,090 / 526,500	6,100	bituminous	88
inc. 14½ / arc. 14	20 / 10	1,000 / 3,400	290,000 / 476,000	6,048	buckwheat	126
15	1,600	52	1,248,000	6,500	buckwheat	192
24	373	112	1,002,624	8,190	Pitt-burg	122
14	22⅓	1,000	312,666	2,880	Leh. V. pea	109
7½	310	115	267,375	3,500	bituminous	76
inc. 6½ / arc. 6	156 / 30	120 / 120	121,680 / 21,600	1,681	Cumberland	85
inc. 24 / arc. 8	500 / 100	112 / 9.6	1,344,000 / 7,680	16,000	hard rice	152
pwr. 24	200	225	1,080,000			
16.3	33.56	1,000	547,028	4,805	buckwheat	114
inc. 12 / arc. 5	25 / 8½	1,000 / 1,000	300,000 / 42,500	4,800	bituminous	71
inc. 15 / arc. 7	26 / 350	1,000 / 45	390,000 / 110,250	7,380	slack	68
inc. 7 / arc. 12	180 / 9.5	110 / 2,700	138,600 / 307,800	6,760	Sidney	46
inc. 18 / arc. 12	30 / 6½	1,100 / 1,800	594,000 / 140,400	4,300	buckwheat	170
6½	122	110	87,230	1,400	blt. slack	62
8	inc. 19.25 / arc. 9.6	1,100 / 1,500	284,600	2,000	pea	143
25	1,200	125	3,750,000	55,420	soft coal	68
10	220	112	246,400	2,100	coal	117
10	217.7	113	246,001	5,320	lump	46
6	inc. 22 / arc. 6.8	1,060 / 1,500	201,120	1,800	.....	112
5	120	112	72,800	1,800	slack	40
9	120	125	135,000	2,400	bituminous	56
10.46	....	....	1,180,306	16,053	good lignite	73
14 / 11	200 / 10	110 / 1,500	308,000 / 165,000	12,000	slack	40
11	20	1,100	242,000	3,200	McAl. lump	76
7⅓	203	115	171,197	3,640	Iowa slack	47
14	inc. 30½ / arc. 52	1,000 / 102	501,256	7,500	buckwheat	67
inc. 7½ / arc. 7½	14 / 10	54 / 1,000	5,670 / 75,000	3,200	coal	25

Average watt-hours per pound coal, 91.7

Central Station Storage Batteries.

The discussion on central station storage batteries at the National Electric Light Convention was opened by Mr. Wm. Bracken, who claimed that now all of the storage battery interests in this country had come under one flag, and that besides the advantage of peace there was the additional one resulting from a combination of experience. As to guarantees, he stated that he knew of no company asking a larger percentage for maintaining a battery than 10 per cent.

Mr. Salon said that the question of the use of storage batteries at the present time in central stations was a purely commercial one. He advised each station manager to settle this for his own case, first ascertaining the cost of generating his power, and the various factors involved in that cost and then determining whether, with an additional investment for a battery with a given output and efficiency and at a given cost for maintenance, he can advantageously add to his plant a storage battery. Mr. Salom stated that the life of a battery under reasonable working conditions is directly proportional to the amount of lead used, and that his company would undertake to build a battery that will last one hundred years, if any one were willing to pay for it.

Mr. J. Appleton described the storage battery plant of the Germantown, Pa., Electric Light Company, which, he stated, was the first installed in this country of American design and manufacture.

The Germantown company had a day load of incandescent lamps and motors on the three-wire system, which was very unprofitable, and about 15 months ago they decided to try the use of a storage battery, to see if the day load could not be made profitable instead of a dead loss.

A small battery was put in, sufficient to carry the day load. Its capacity was 800 ampere hours, with a normal rate of discharge of 80 amperes.

The machinery was then shut down from daylight till dusk, the battery taking care of the day load.

This being an experiment to ascertain the true facts about the working and value of a storage battery for central station purposes, very careful figures were kept, and the result of the first year's working was eminently satisfactory, and showed a saving in labor, coal, water, oil, waste, etc., not counting the decreased depreciation of machinery due to shutting down from daylight to dusk, $2,500. Besides this there was a great advantage in being able to overhaul and examine all machinery in the day time while everything was shut down.

This being so satisfactory, and the behavior of the battery being equally good, the Germantown company decided to put in a battery of two and a half times this capacity, which would enable it to increase its day load, and consequently increase the savings, as the cost of charging a large battery is only the extra fuel required. This larger battery was installed at the beginning of this year, and is the one illustrated herewith.

The battery consists of 120 cells of the chloride type, *G*, eleven plates in each, arranged 60 on each side of the three-wire system. The capacity of each cell is 1,000 ampere hours, or 2,000 hours with both sides; the normal rate of discharge is 200 amperes, with a maximum of 400 amperes, and this can safely be increased in case of sudden demand or emergency.

The plates are protected by asbestos insulation, and are contained in lead-lined wood tanks. An asphalt floor, well drained, is provided, so that there is no trouble in handling the acid.

One special feature of these cells is the size of the plates of 15 inches by 15 inches, which involves much less trouble and expense in the maintenance, there being only 11 plates to give 1,000 ampere hours' capacity, instead of about 80

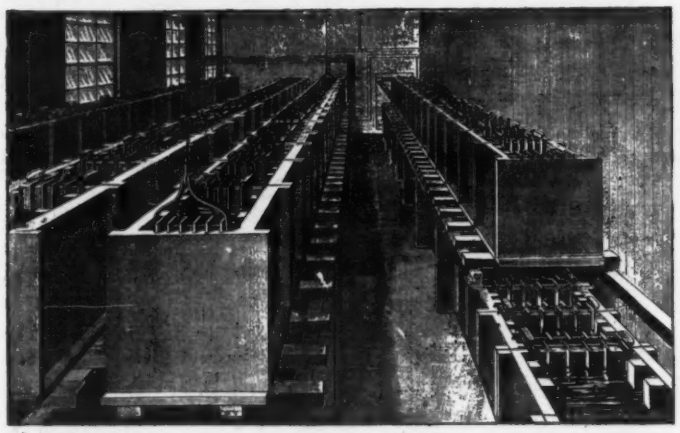
plates, as in most other types of batteries. Plates of the chloride type can be constructed larger than this without any difficulty, and give equally good results.

This battery plant has been designed to meet all the requirements of the three-wire system, and to give the greatest possible flexibility. The ordinary course of working in the Germantown station is as follows:

The machinery is shut down at daylight, and the battery carries the whole of the day load till dusk, when the dynamos are started again. The battery is then started out during the hours of heavy load and started in again for charging when the load decreases. By this means the general plant is working at an efficient load during all the hours it is running, and the extra fuel for charging the battery is hardly noticeable.

The daily routine is very simple; the discharge of the battery is noted by hourly readings, and at the end of the day the total discharge is ascertained. A charge of about 10 per cent. in excess of the discharge is put on, and this is found to be sufficient; in some cases even less charge than this will bring the cells up to the proper E. M. F. Just before the end of the charge readings are taken in some of the cells with the hydrometer and voltmeter, and the condition of a cell can be accurately obtained by this means.

Until recently sufficient attention was not paid to designing the cells for the work they had to do. Engines and dynamos are designed and installed according to the nature



GERMANTOWN STORAGE BATTERY PLANT.

of the work they have to perform, and this must be done with batteries.

Given a properly designed and installed battery, such as the one described, the maintenance and depreciation will not exceed that of the other portion of a central station plant. A storage battery does require attention, but not skilled attention; the most important thing is to give it regular attention, and to not leave it for weeks and months till some fault develops, but treat it like other machinery, overhaul it regularly and prevent the occurence of any fault.

There are many stations in this country which are running the day load at a loss, or are losing business by not supplying current at all in the day. To these stations a battery plant would be invaluable and would give a very different result when the balance sheet is taken out.

In many cases it would, of course, be best to leave the battery on the line always, and then when the general plant is running the battery acts as a regulator, taking up any fluctuation in the load, relieving the generating plant and keeping the potential constant.

Again, in some stations the load carried takes the form of a sharp peak for a short time during the evening, when most of the lights are in use. A battery will assist the dynamos during the period of maximum load, and saves the necessity of providing a generating plant, which will only be used for a very short time during the 24 hours, standing idle and unprofitable the remainder.

There is another question, too, which electric light men have to face: How can we profitably reach the outlying districts with our direct current mains? Here again the battery plant proves valuable. Small sub-stations in the outlying districts can be built for the batteries, and those can be charged in sense from, say, 400 to 500 volts and the current distributed at the required pressure.

Things have now changed; figures, facts and guarantees are obtainable, which will enable electric men to feel that storage batteries, as a whole, are not what they were, but when properly designed, manufactured and installed are to be welcomed instead of shunned.

In the general discussion which followed, Messrs. De Camp, Nichols, Wright, Van Trump, Barstow and Williams took part. Mr. Wright stated that he was connected in an unofficial capacity with the Germantown Electric Company, and that he had found that its loss by the entire incandescent business was exactly the loss on the day circuit, while with the battery there was a saving of $2,500 and a net profit on this business of $700. The battery earned about 35 per cent. of the investment the first year.

Mr. Barstow related his experience on a tour of inspection of storage battery stations in Europe, and said that although he left the United States prejudiced against their use, he returned converted in their favor and installed a plant in the Brookly Edison station.

The Importance of Complete Metallic Circuits for Electric Railways.

Mr. J. H. Vail, in his paper with the above caption, read before the Washington Electric Light Convention, after briefly reviewing the practice of the last few years in street railway circuits, gives several instances of damaging electrolytic action from ground returns. In one case an electric arc formed across the ends of a pipe being separated for repair by a plumber, and in another a fireman received a shock when opening a furnace door, while a case is known of a house being set on fire through an arc forming between a water and gas pipe, eventually burning a hole in the latter. The effects of electrolysis are referred to, and illustrated by a section of 6-inch water main shown by Mr. Vail, which had been corroded through two and one-half years after laying. After citing other evils of the earth return, including the frequent waste of energy through high resistance, the present system of banding of rail joints is criticised, as well as the usual method of employing supplementary wires, the statement being made that 99 per cent. of the money spent for supplementary wires is thrown away.

After analyzing the entire matter, the writer recommends the use of the complete metallic circuit, to be obtained by so bonding the track as to render the rail joints of equal conductivity with the rails, and leading insulated feeders direct from the bus bar in the power station to predetermined points of the track system, the feeders being either overhead or underground, preferably the latter.

The author had observed on some roads that large quantities of copper for return circuits have been placed at great expense, apparently without a proper conception of how to obtain the best results. Frequently a far less amount of copper, judiciously applied for improved distribution by the feeder system, would give superior equalization of pressure at reduced cost.

If for the movement of cars singly or in quantities at a high rate of speed the electric current is to be distributed uniformly over an electric railway system, the subject must be handled with as much scientific accuracy as is always used for a perfect system of incandescent lighting, in order

to obtain equal distribution and free flow of current in both sides of the system.

The author states that he has fully and completely provided for all contingencies in the following manner:

First. By a careful study of the conditions under which a system will be operated; these important points being ascertained with reasonable accuracy, the requisite supply and distribution of current for the service is determined, and the system of conductors arranged to meet the requirements.

Second. The conductivity and current carrying capacity of the track system is calculated, and a system of insulated track feeders is provided, leading from the switchboard in the station and connecting at predetermined points, and with a calculated fall of potential.

Each feeder must be determined for its maximum current requirements at a stated drop in potential. The actual work required of the feeder and number of track feeders necessary is determined upon such factors as:

The cars in service—their weight, speed and headway; the position of power station and the geographical lay of the railway system; the weight of rails, and whether double or single track, and the amount of load concentrated on sections of track between feeder junctions.

The carrying capacity or conductivity of the sum total of all the feeders of the system will be found to give complete and ample circuit for the free flow of the entire current required, and to take care of extra heavy traffic and blockades at any point.

The parallel track main is only applied in sections of systems extending over very large territories and long distances.

The conductivity of the rails is calculated with as much care as the overhead system, and when the track needs reinforcing the purpose is accomplished by laying a thoroughly insulated main line (not a bare line) and making frequent sub-feeder connections bonded to the track. If used at all this main will be of large size.

Such a system, accurately worked out, will show by actual test with instruments on the cars a surprising equality of electromotive force throughout a large territory.

A very careful test has been made with instruments on moving cars, throughout a system covering forty miles of streets, with double tracks, equal to eighty miles single track. The readings showed: Maximum volts, 512; minimum volts, 420; average of electromotive force over entire system, 460 volts, the electromotive force in station, at bus bars, being 520 volts. The feeders were calculated for 10 per cent. drop. The actual average drop from dynamo to motor does not exceed 12 per cent.

This will be found to result in reduced fuel consumption, better working of the motors, a most satisfactory reduction in repair accounts, and an improved general economy of the entire system.

In the system of distribution secured by the above method the use of ground plates, rods or other insufficient methods is needless; the current travels only over the paths provided for it, and electrolysis of gas and water mains is entirely obviated.

Part was taken in the discussion that followed by Messrs. Burleigh, T. C. Smith, Mason, Law, Cuttress, Brophy, Young, Harrington, Seeley and Wright. The fishplate was pronounced useless for bonding. Mr. Wason expressed the opinion that rail bonds would not do away with electrolysis and favored electric butt-welding the joints, but neither Mr. Vail nor Captain Brophy believed electric welding practicable. Mr. Law spoke of the success of the Love underground system, which did not require rail bonding, and Mr. Cuttriss spoke of the evil effects of the return circuit on the working of cable and telegraph instruments. Mr. T. C. Smith referred to the effects of contraction and expansion, and quoted a case where a mile length of rail had been joined by extra long fishplates with six rivets on a side, and yet no increase or decrease of length had been noted.

Arc Lamps on Incandescent Circuits.

Prof. L. B. Marks opened the discussion of the above topic at the Washington convention by describing a new high potential incandescent arc, the invention of himself and Mr. C. Ransom. By confining the arc in a very small bulb filled with carbon gas the current can be reduced and the potential increased with excellent results. No difficulty had been met in running 100 to 120-volt arcs in this way. The bulb used for the purpose is a modified Howard cylinder, containing a special device for controlling the inclosed gas.

When operated under these conditions the arc is about half an inch long and very steady. The violet hue, so common to open air long arcs, is not marked, the quality of the light being especially valuable for in-door illumination. The life of a pair of 7-16-inch carbons in a 500-watt lamp is about 100 hours, and the necessity of running two lamps in series is dispensed with, a single arc without appreciable dead resistance being sufficient to bridge the mains. The consumption of carbon is so slow that even if the points are fixed the P. D. between the electrodes will not increase more than a few volts per hour.

With a P. D. of 115 volts between the carbon points and a current of 4 amperes, a single lamp consumes 480 watts on a 120-volt incandescent circuit, the amount of energy expended in the arc itself being 460 watts. The loss equals 20 watts per lamp, or 40 watts for two arcs, each directly across the mains. Comparing these figures with the data obtained from existing conditions under the most favorable circumstances, the loss of energy for two open air arcs, each 460 watts, across a 120-volt circuit, is 280 watts, as against 40 watts in the first case. Thus, there is a clear saving of about 20 per cent. in energy accruing from the use of the high potential lamp.

In the lamp there are two regulating coils differentially wound on the same core, and in series relation to each other, one coil being in series with the other in shunt around the arc. By properly proportioning the coils we have obtained a very sensitive feed. The claims made for the lamp arc: (a) Saving in energy; (b) saving in cost of trimming; (c) saving in carbons; (d) improvement in the quality of the light; (e) subdivision of the light; (f) cleanliness, no carbon dust or soot; (g) perfect spark arrester.

Mr. Barstow, of Brooklyn, stated that the disadvantages of low tension arc lighting are of immediate concern, first, the requiring of a dead resistance in the circuit of the lamps, which means lost energy; second, the installation, for commercial reasons, of lamps in pairs. He said that the low tension direct current system could easily manufacture current cheaper by using large units operating multiple than a high tension system with its larger number of small machines. He had been assured by a large company operating circuits on both high and low tension systems that it cost it 25 per cent. less to generate current for low tension than for high tension arcs. The question of the desirability of installing lamps in pairs must be answered by the consumer, and in Brooklyn the results will warrant a strong affirmative.

In regard to a price for current for low tension arc lamps, renewals must be taken into account, and the renewal of the lamp resistance as well.

In order to get the same price for an arc current as for an incandescent current, which, of course, comes from the same generator, the price of current per 16-candle power lamp hour was taken as a basis. It was then found that 9 cents per

hour for a 1,200-candle power arc lamp current corresponded with 8 cents per hour for equivalent incandescent current, as the proportion of arc lamp renewals exceeded the incandescent. As the cost of labor in trimming an arc lamp is the same whether the lamp is burnt for one, two or six hours, it was found that in order to be fair in a meter rate a sliding scale should be used. Therefore, a scale commencing at 9 cents per lamp for the first hour and decreasing in proportion to the length of burning was adopted. It was further thought that if customers paid for current actually used without reference to the number of lamps installed, and the company was to loan the lamps, there would be no limit to the number of lamps asked for, while the customer would not bind himself to use all of them. This difficulty was easily settled by grading the discount price of current according to the lamp average hours per day, which was obtained by comparing the total current with the number of lamps installed.

The first pair of arc lamps were installed in Brooklyn, where, indeed, the history of low tension arc lighting began in the spring of 1890, and since then the progress has been very rapid, as the Brooklyn Edison station is now operating 2,700 lamps, with orders for 400 more.

It has been shown that low tension arc lamps can be furnished as cheap as their high tension competitors, and still yield as much profit as an incandescent installation. The growth of the business can only be ascribed to the fact that the light is good, the control of pairs by individual switchboards a great advantage to the customer, as is also a meter basis for bills, and the further fact that very ornamental fittings can be used.

The following table is a complete report on arc lamps for the year 1893, which will show clearly the defects which are now being corrected:

DATA.		
Number of Ward lamps in use	2,246	
Number of Bijou lamps in use	400	
Total number of complaints	3,911	
Defective carbons	2	per cent.
Retrims	7	per cent.
Defective adjustment	12	per cent.
Fuses and plugs blown—unknown cause	10	per cent.
Loose connections caused by storms	6	per cent.
Trouble with mechanism of lamp	12	per cent.
Carbon holders broken and burnt out	1	per cent.
Lamps grounded external	8	per cent.
Defective cleaning	16	per cent.
Defective house wiring	2	per cent.
Resistances burnt out and grounded	5	per cent.
Defective installation	1	per cent.
No trouble when men arrived	10	per cent.
Special complaints	8	per cent.
Total number of trimmers	17	
Average number of lamps per trimmer	144	
Maximum number of lamps per trimmer	170	
Maximum trims per trimmer	182	

Labor and material for repairing, repainting, rewinding resistances and changing lamps, including testing of all new lamps, 75 cents per lamp per year.

Globe renewals, exclusive of those paid for by customers, 7 cents per lamp per year.

The Brooklyn company is now working on a system of carbon renewals, which plan, although not a novel one, will, if finally successful, effect a considerable saving.

Mr. Andrews, of Philadelphia, said he had introduced a considerable number of arc lamps on incandescent circuits and had increased the income of the station. In many stations where customers had complained about the quality of incandescent lights they had been replaced by arc lamps at double the expense, but with four to ten times as much light, and the customers had been perfectly satisfied. He thought that in general arc lamps on incandescent circuits would eventually supercede the high tension arc lamp, one of the reasons being that they could be turned on and off at pleasure. He used both direct and alternating current lamps, and he regarded the alternating arc lamp as a great addition to the central station income, as well as possessing the advantages of great flexibility. Charges were made by meter exclusively, the rate being 15 cents per kw. hour, with a varying discount according to the size of the bill. The company supplies the carbons and trims the lamps. He said that they had tried nearly every carbon manufactured in this country, and had come to the conclusion that it was impossible to produce a perfectly satisfactory light. Mr. Andrews, therefore, regarded an improvement in the manufacture of carbons as very essential, and was supported in this by Mr. Ayer and others.

Mr. Van Trump stated that they had installed some arc lamps on incandescent circuits at Wilmington, and were running series arcs as well. They were charging a rate of 10 cents per watt hour, or about 21 cents per kw. hour, with a minimum charge of $12.50.

Mr. Stetson stated that he had had trouble about bills, which had proved too high for customers.

Development of Switchboards for Modern Central Stations.

Mr. A. B. Herrick, in a paper read at the National Electric Light Convention, held at Washington, stated that the universal modern practice in regard to the location of switchboard, both abroad and at home, is to place it in a gallery, or in some elevated position, where the attendant has full observation of the operation of the different units under his charge, and can judge, in the case of any peculiar behavior of the generators, the proper remedy to be applied, and be prepared to take the unit off the circuit if necessary. There is another marked general tendency in switchboard construction; that is, to make the whole structure absolutely fireproof. This is, of course, an economical investment, for lower insurance rates are easily obtained on central stations properly safeguarded.

In the case of low equal potential distributing systems, especially in the three-wire feeder and main system, the switchboard arrangements bear a very important relation to the satisfactory operation of the system.

In order to distribute the current at a high economy by means of the feeder and main system, it is necessary to place the station at the average centre of distribution. This simple proposition is complicated by the fact that a city is divided into business and residential portions, each having different periods of maximum demands on the station, and as these districts are not generally symmetrically located, as regards the station, the centre of maximum efficiency of distribution travels over considerable distances during the day.

Different methods have been adopted in the past in order that the station may deliver its current to the mains at an equal potential; in other words, artificial means have to be used to bring the varying centre of distribution to the station.

As the low potential systems have been expanding over larger areas to include a greater number of customers, it has become necessary to deliver current at the station ends of feeders at different potentials to compensate for the unequal loading of the system. This was originally effected by running the dynamos at different potentials, feeding into independent busses, the feeders being so arranged that they could be thrown on any of these busses and supplied with current at the proper potential to deliver their current to the mains at a uniform potential. When the units in the station were small they could be divided up on the different busses with comparatively high economy, but, as central station business has expanded, units had to be adopted, both for economy and first cost per kilowatt, higher economy in current production, and to obtain a larger kilowatt output per square foot floor space. With the introduction of these large units two conditions confront the engineer—one: it

was necessary to run the unit at nearly the maximum output in order to get the maximum efficiency of the generators and engines combined; and the other, to deliver this current at two or more potentials to different groups of feeders.

To follow the ordinary load diagram of a station, beginning at the lowest point, it is very rarely required to produce the current at more than one potential. Here all the feeders may be thrown on one bus bar, or the bus bars may be tied together. As the load rises certain feeders will become more heavily loaded, and they will have to be supplied with a current of high potential, but to run a large unit on this high potential bus, where the load it has to carry is a small part of its total capacity, it would be an uneconomical method of producing this current, as the unit under these conditions is working disadvantageously both as regards expansion of steam in the engine, the friction, field and armature losses. Several different methods are now used to effect a higher economy in the delivery of the current to the busses. Mr. Barstow, general manager of the Brooklyn Illuminating Company, has devised the well-known "booster" system. This method works out very well where three potentials are required. The medium potential bus in this case is fed by the units operating the station; the current is delivered from the medium bus to the high potential bus through the armature of a dynamo whose field is separately excited. The current in passing through this armature has its initial potential exalted, and the amount of this increased potential is controlled by a field regulator. The currents supplying the bus of lower potential than the medium bus also flows through an armature, but in this case the armature is rotated as a motor and has its initial potential reduced. In the three-wire system two "boosters" are required for each potential, and it is the usual practice to couple these boosters together, making one continuous line of shafting, to which is also coupled a motor for the purpose of keeping the boosters up to full speed and making good the losses due to transformation and unequal loading of the high and low busses. The losses inherent in the booster system are those occurring from friction, armature losses and field excitation.

A method has been devised by which to obviate these losses, a dynamo being used to produce on a single armature two or more potentials. Where the difference of potential is small, and where the load on the high and low busses does not fluctuate very rapidly, a smooth body, multipolar, direct driven dynamo can be used; but where the differences of potential and load are extreme a special dynamo is applied, and different parts of the armature run at different potentials and on two or more separate busses. Its action will be similar in every respect to that of two or more independent dynamos. The different parts of the armature giving different potentials are controlled by separate regulators, and the load on these separate busses carried to a point at which it will be economical to operate a separate unit. Then this special dynamo can be connected to any one of the busses in the same manner as any other unit in the station. The different parts of the armature are brought to one potential and thrown in on any required bus in the same manner as in the operation of three separate dynamos. In this way some of the losses inherent in the booster method are obviated, and full economy of the supplementary bus output is always obtained; and the full load of these auxiliary busses being carried by the one dynamo, brings the output of this dynamo up to an efficient point, both as regards the operation of the engine and dynamo.

After having thus reviewed the methods of producing different potentials in the station, we come to the modern switchboard, which has required very careful thought on the part of the engineer to make both simple and easy. Following the natural operation of the switchboard, provisions made to take care of the field circuits are the first requiring our attention.

In the introduction of the modern multipolar machine great attention was necessary in the field circuit arrangement, and the proper method of exciting dynamos is still an open topic. Two methods are commonly used, each having its own peculiar advantages and specially applicable to different systems—the self-exciting, bus-exciting. The advantages and disadvantages of these methods are as follows:

In the self-exciting method the field terminals are connected to the brushes. The advantage of this is that the field gradually dies away as the dynamo slows down, and when the dynamo has stopped the field has entirely disappeared. The danger of a sudden discharge of the field, which would submit the field winding to a strain, on account of the high potential induced, or breaking down the armature is thus avoided. The disadvantages of this method are: First, the slowness with which the dynamo builds up its own field, as the dynamo frequently runs at full speed for some time before it develops sufficient electromotive force to be connected to the system; second, the possibility that the field may build up reversed. This may be caused by the sudden discharge of the field by a short circuit, or even by proximity to another dynamo.

In the bus-exciting method the fields are connected to the station mains or busses. The advantage of this method is that the field is instantly made and the dynamo can be connected into the system as soon as it is up to speed. The polarity of the field is always the same and cannot be reversed. In bus-exciting of large multipolar dynamos the taking of the field off the bus introduces into a system of low potential a high potential discharge, which submits the field insulation to a strain, which can be avoided in several ways. One method is by taking a special switch, which, before severing the fields from the bus, connects the fields in such a way that it is divided into halves; the electromotive forces of discharge are opposed against each other and consequently die away without having any effect.

The disadvantages of the bus-exciting method are: First, that in case the system is short circuited, sufficient potential cannot be generated to burn out the short circuit; second, if the dynamo is operated on a different bus from which it is excited, full output of the machine cannot be obtained in case the exciting potential is lower than its working potential.

The electrical data which is used in connection with switchboard designing is as follows:

Regarding bus bars, the most economical point to carry the current density in copper bus bars is 1,500 amperes for naked copper bar 2 1-2 inches by 1-2 inch.

The most economical size of bus bar, radiating and cross-section considered, which has also sufficient mechanical strength, is a bus bar 4 inches wide by 1-2-inch thick. This is called the standard central station bus bar. They are placed in multiple to make up the required carrying capacity with 1-4 inch between the 4-inch sides, and the long sides are placed vertically. This gives ample space for dissipating the heat by radiation and convexion. This space between the bars makes a convenient place for inserting lugs, and can be secured by means of bolts passing through the bus bar. Brass will carry from 400 to 500 amperes per square inch, depending upon its conductivity. In regard to the current carrying capacity of contacts, this depends both upon the area and pressure, the pressure playing the most important part. In ordinary switch blades, where they are carefully assembled, 60 to 80 amperes per square inch should give a contact which should heat not over 20 degrees Fahrenheit above the surrounding air, carrying full load con-

tinuously. In the matter of switches, the perfect adjustment of the contact surfaces, the wearing surface of the contacts and the conductivity of their terminals should be all taken into consideration in the design of these appliances. In the matter of contact surfaces for connections of the different appliances, a taper plug, when ground to its seat, will carry 180 amperes per square inch, and laminated blades, bolted together, will carry 120 amperes to the square inch. A well faced lug screw down to a true surface, by means of bolts, will carry 190 amperes per square inch of surface. It is necessary in designing contacts to keep the temperature within 20 degrees rise above the temperature of the air, to have the conductors leading to and from the contacts of ample capacity to carry the current, and also to assist in radiating the heat that may be generated in these contacts; and the above current densities for contacts are given when the matter of ample adjacent conductors has been embodied in the design.

A word in regard to temporary work in stations would not be out of place here. A great deal of temporary work done, especially in switchboards, is a reflection on good engineering. There is no reason, with foresight on the part of the designer, why a great deal of this work could not be obviated, thereby saving labor and capital being expended which has only a short period of dividend earning capacity and on which expenditure a dividend has always to be earned as long as the plant is in existence.

The iron framework is the best for switchboard construction, and is constructed with standard steel channels and T's. The framework is made in sections and can be readily taken down, and where it is secured to any metallic portions of the station building it should be carefully insulated from it. The frame is usually set on top of the slate floor, which makes a very serviceable flooring for a gallery, and all bolts going through the iron framework of the switchboard should be insulated where they are in contact with the beams under the floor. With a grounded neutral the insulated iron framework has great advantages, both in regard to leakage and in working behind the board. A four-foot space should be allowed between the walls and switchboard for convenience in working and erecting.

In the case of the switchboard carrying different potentials, such as arc light, railway and incandescent circuit, the different parts of the iron framework are also insulated from each other. The materials best adapted for the switchboard slabs can be of carefully tested slate, a chocolate colored fine grain Tennessee marble, or light gray marble, used largely in the West. Italian marble is very good, and makes the most effective switchboard, and if care is exercised in keeping it clean, it is very durable. Tennessee marble of the proper quality should drill nearly as readily as slate, and is the most durable of all the marbles.

A line of porcelain insulators is very convenient for station wiring for bare cable and copper rod, which can be built up in any form to lead the conductors through the station, either on iron framework or recessed in the wall. The cost of station conductors can be cut about 20 per cent. by the use of bare conductors. Solid copper wire on porcelain insulators give very high insulation, and in exposed places can be served with asbestos twine, which affords the conductors protection from mechanical injury, and fire cannot be transferred along the conductors to other parts of the building. A welding machine is very useful in connecting the adjacent lengths of copper rod, and provision for expansion is made at elbows by a flexible laminated L. Bus bar supports are also made of porcelain, doing away with all inflammable material in the switchboard and for the wiring of the station, and reducing the insurance risk on this class of property.

It will also be noticed that all conducting parts and switch contacts are made more massive than in the old type appliances. The economy of this is very apparent; for instance, if a thousand ampere switch were used which had an average elevation of temperature of 20 degrees Fahrenheit above the average air temperature of the station, this would mean an average loss of 72.2 watts, and with electrical horse power delivered at $60 per year, the energy expended in heating this switch would cost nearly $6 per year. From this it is evident that a switch possessing more material and contact surface would be a very economical investment. These points of sufficient carrying capacity unfortunately do not become evident until the station becomes fully loaded.

If any part of the switchboard passes an average of 20 degrees Fahrenheit above the surrounding air, the high water mark for economy has been passed in the design of this board, and it is unprofitable to pass the current through devices whose temperature averages more than 20 degrees Fahrenheit. In this case the manufactured product of the station is uselessly wasted in its transmission. It should be utilized for earning dividends by passing it through the meter of the consumer instead of wasting it in the station.

In the discussion, Mr. Weston criticised the adoption of 20° as a standard of temperature. All resistances should be made as low as possible and great attention given to joints and the material used in a shape giving the largest cooling surface. The losses in various cases investigated through defective joints and conductors and switchboard instruments with higher resistance than necessary were expressed in dollars and cents per annum. In one case a single switch and instrument involved an annual loss of $5,000. In conclusion, Mr. Weston recommended that the switchboard be brought as near to the dynamo as possible, and every inch of unnecessary conductor should be left out. Every joint should be left out that possibly can be, and when joints are made they should have large surface contacts. Conductors should not be circular, but flat, and have plenty of air, so that there can be an abundance of the cooling action of the atmosphere.

It is clear that the stations should be so arranged that the feeder circuits are as short as they possibly can be. The switches must be made very differently from what they are now; polished brass looks pretty, but it is not what you want; do not sacrifice good qualities for appearance. The conductor should be given plenty of space; they should not be laid flat on one side of the switchboard, placed upon a slab, and closed at the bottom. Keep the temperature of the conductors down as low as you can; it may even pay to put an oil bath around conductors and cool the oil by water.

Practical Properties of Polyphase Apparatus.*

BY LOUIS BELL.

The author states that while most of his personal experience has been with triphase currents, much of what he has to say is quite applicable to systems having more or less phases, provided, of course, that such systems are symmetrical. Of those wherein this condition is not filled he will refer to in discussing polyphase motors. It is also pre-supposed that currents giving tolerable approximation of sine waves are dealt with. While any departure from this theoretically causes loss of energy due to the presence of higher harmonics, electrical power transmission must be developed in conditions beyond those that now seem extreme before the current curves now readily obtainable will need revision.

*Abstract of a paper read at the eighty-third meeting of the American Institute of Electrical Engineers, Jan. 17, 1894.

Cases are referred to later in which the form of the curve is really a matter of decided importance.

While the general character of polyphase dynamos must closely resemble that of the ordinary alternator, the necessity of applying to the same armature two or more phase windings leads to modification of the design so far as the winding is concerned, and quite generally in the direction of the direct current type. It may sometimes be useful, too, to derive polyphase currents from two or more ordinary alternators with their shafts coupled together, or from composite machines having phases on separate armature cores, but these devices are rather to be regarded as expedients convenient for divers reasons than as final types. This is on the broad general principle that one large machine is more economical than two or more small ones aggregating the same output, and that the more completely the armature core can be utilized the better output can be obtained from the same structure. Therefore, with similar machines of equal size and equal magnetic and electrical constants, a polyphase armature winding does give a better output than a single phase winding. Of course it is possible to construct a single phase machine that shall give a better output per pound of weight than a certain concrete polyphase machine, just as one might manage to double the voltage obtained from a given armature while retaining the same output, but other things being equal, the more phases the better output in a given structure. All this has been made so clear of late that it is only necessary to emphasize the fact, that while the difference in output between a single phase and a two phase armature is quite considerable, the step from two to three phases is somewhat less marked, and that from three to more of relatively little importance.

The tendency in building polyphase generators is certainly toward the development of a rather better machine than we have become familiar with in the ordinary alternators, due mostly to the impetus given alternating current machinery in general by recent demands. This has led, first, to the adoption of a lower frequency than formerly, both to facilitate the use of motors and to avoid the serious difficulties due to inductance on the long lines that are now becoming more common. Second, it has caused more attention to be given to the production of generators able to take care of fluctuating and inductive loads, such as are produced by motors, without excessive over compounding. With a properly designed machine the popular idea of the difficulty of regulation under an inductive load is grossly exaggregated. A generator built, as alternating generators should have been built long before now, with proper attention to the production of a good machine for all around practical work, will take care of an inductive load of the severest kind more easily than the average alternator found to-day in central stations will handle a load of incandescent lights.

The practical ease of regulating a polyphase generator under an inductive load is shown by the results of some experiments recently tried with a triphase generator of 260 kw. normal output, run at 600 revolutions per minute and a uniform voltage of 2,500 volts between lines. Accurate readings were taken of the currents necessary to excite the generator, with the following results, the voltage being preserved uniform at 2,500:

Exciting current output about 30 kw. No lag.....19.05 amp.
Exciting current output about 30 kw. Power factor .2...21.50 amp.
Exciting current output 260 kw. No lag.....2.80 amp.
Exciting current output 260 kw. Powder factor .84.....24.80 amp.

No better test than this could be wished for showing the excitation required under a lagging load. It should be noted that the power factor in the last case was similar to what would be found under ordinary circumstances in running a load of inductive motors, and yet the increase in exciting current from a very light load with no lag to a full load with very decided lag was only 25 per cent. Experiments with other machines under an inductive load show results similar to this, so that I think we can safely say that a well designed polyphase generator will take care of an inductive load easily and without excessive variation of the field strength. More than this, the regulation required can easily be made automatic in cases where this method is preferred to hand regulation, which, however, answers most purposes very well.

Of course the polyphase generator can be made self-compounding in a manner closely analogous to that followed with an ordinary alternating generator. The rectification of the necessary amount of current makes this method somewhat inconvenient in large machines. In such cases, we may effect a very complete automatic regulation by the following means:

The generator is excited from a rotary converter taking its polyphase current from the main machine of which it feeds the field magnets through its direct current side. In the lines between the rotary converter and the generator are inserted inductive resistances which serve to cut down the voltage applied to the polyphase end of the rotary converter. On these choking coils are, however, reversely wound turns from the main circuit of the machine. The result of this arrangement is, that as the current in the main line fed by the generator rises, the inductance in the line which feeds the rotary converter is gradually removed, allowing the voltage to rise higher and higher, in proportion to the current in the main line.

Fig. 1 gives a clear idea of the arrangement. In this figure A' is the field magnet of the main machine, of which B is the armature, a the three collector rings, the machine being of triphase type; $F\,F$ are the field magnets of the rotary converter, of which D is the armature, b the collector rings and E a commutator delivering direct currect to the fields of the rotary converter $F\,F$ and to the field magnets $A'\,A'$ of the generator. The rotary converter may conveniently be brought up to speed by its pulley P unless another triphase machine be at hand by which to start it; $M\,M'\,M''$ are the three inductive resistances, e the windings connected with the rings b, d the reversely wound turns connected to the main line. Of course, transformers may be inserted in the line between the inductances

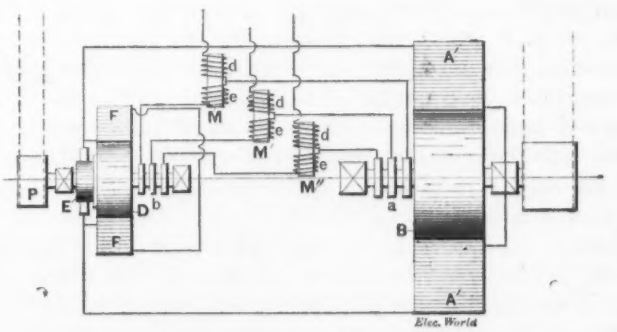


FIG. 1.—DIAGRAM OF APPARATUS.

and the rotary converter if the voltage of the main generator renders it desirable. In fact, such converters wound with cumulative turns from the main circuit may replace inductive resistances. I have experimented rather more, however, with the form shown in Fig. 1. It may sometimes be convenient to employ the rotary converter merely to excite an auxiliary compound winding, in which case it can be started up from the generator already worked up nearly to normal voltage of its own exciter.

(To be continued.)

The Electrical World's Digest of Current Technical Electrical Literature

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

ELECTRO-PHYSICS.

Properties of the Alternating Current Arc.—An Academy paper of Mr. Claude, reprinted in abstract in "L'Ind. Elec.," Feb. 10, describes the following phenomena: A condenser of 1 microfarad, a key for closing the circuit and 12 lamps of 100 volts were connected in series to an alternating current circuit of 2,400 volts and 80 periods; on closing the key the lamps reddened, due to the charging and discharging current of about 0.1 ampere; on opening the key, so as to leave a break of short length, an arc was formed at these points and the lamps increased greatly in brilliancy; they increased until the distance was about 1 millimetre, the increase being from 30 to 90 volts at each lamp; the difference of potential of the arc was 1,200 volts and the intensity was 0.4 ampere, but it did not consume 480 watts, as the contacts heated only slightly, and it seemed as if the arc was a nearly perfect self-induction; in reality, the explanation is as follows: The arc passes only when the difference of potential is sufficient to discharge through the air, and the condenser is therefore charged suddenly by a high electromotive force, instead of being charged gradually, as it is when the circuit is closed; the charging current is therefore of very small duration and of much greater intensity, and the mean of the squares of the intensity is therefore greatly increased; this explains why the power absorbed in the arc is so small; with carbon points only 500 to 600 volts could be obtained at the arc, with a length of 3 to 4 millimetres; an arc alone in series with the lamps diminishes their intensity; the experiment can be shown best with a current of a frequency of four, as generated by a modified Gramme machine.

Abnormal Resistance of Liquids for Alternating Currents.—An article by Mr. Lohnstein, abstracted in the "Elek. Zeit.," Feb. 8, states that when certain electrolytic cells are connected with a galvanometer in the secondary circuit of an induction coil, a relatively great and continuous deflection will be obtained, which, with an increased frequency, changes to the opposite direction; the effect is greatest when zinc plates are used in zinc sulphate solution; he does not offer any explanation.

What Is Electromotive Force?—An article under this heading by Mr. Schwartze is published in the "Elek. Anz.," Feb. 4; it is one of a series in which he endeavors to show that there are great errors in the conception of electric units as usually published in text books.

Ohmic Resistance.—The "Elek. Anz.," Feb. 10, contains another article by Mr. Schwartze, in which he discusses the real nature of electric resistance and magnetic reluctance, claiming that it is a misleading error to assume that a resistance is a velocity; he claims that many statements in text books are very misleading and incorrect, and that the congresses would have done better if they had occupied themselves with the development of a sound physical foundation of electrical quantities.

Dielectrics.—The "Elek. Zeit.," Feb. 8, abstracts from a Vienna journal a paper by Dr. Benischke, in which he describes the measurement of the dielectric constants of a number of different substances with alternating currents having a frequency of 80; they are almost all smaller than those usually used; neither high voltages up to 1,100, nor increased time had any effect on these constants; a slight variation was observed for paraffine for that high voltage; he does not believe that a permanent change is caused by alternating currents.

Dielectrine.—In addition to the information given last week, "L'Ind. Elec.," Feb. 10, states that this substance resists strongly changes due to the atmosphere, samples of it having been tested for two years; it is specially applicable to moist atmospheres.

Electric Waves.—Mr. Deeley, in a correspondence to the Lond. "Elec.," Feb. 16, discusses the subject of electric and magnetic waves in connection with the English translation of Prof. Hertz's book.

MAGNETISM.

Electromagnetic Synchronizing.—The paper mentioned in the Digest last week is abstracted in "L'Ind. Elec.," Feb. 10; the author describes a method for studying the problem.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Electro-Dynamometers Used as Wattmeters.—"L'Elec.," Feb. 3, contains the first part of an article by Mr. Meylan, in which he discusses very clearly the best conditions when they are used for alternating currents. Regarding such wattmeters, he says that if there is a difference in phase between the series and the shunt current (apart from that due to the shunt coil), the power factor, as the cosine of the angle of lag in the case of sine currents, affects to an equal degree the value of the mechanical couple which remains proportional to the watts, while the product of the volts and amperes is then no longer a measure of the power; another advantage is that they can be used for both kinds of currents and can be calibrated with continuous currents, which is a much more exact method. There are two causes of error which limit the application of electro-dynamometers as wattmeters; the first, which is the same for continuous as for alternating currents, is the loss in the apparatus itself, which is easily determined and corrected; the second is that due to the self-induction of the shunt circuit, which, he believes, has not yet been studied practically; a third error is caused by exterior fields, to eliminate which it is only necessary to make two measurements by reversing all the connections and taking the mean of the two readings. In taking up the question of the loss in the instrument, he discusses first the measurement of the energy of a receiving apparatus as distinguished from a generator; there are two ways of connecting a wattmeter; in the first one the shunt coil is connected to the beginning of the series coil; that is, it measures the voltage of the receiving apparatus and the series coil together; in the second case, the shunt coil is connected to the end of the series coil as distinguished from its beginning; the shunt current in that case passes also through the series coil; in each case there will be an error. In the first case this error is equal to the ratio of the power lost in the series coil to the total power which is measured; it becomes greater, however small the resistance of the series coil is, if the voltage is very small; in the second case the

error is equal to the ratio of the energy lost in the shunt circuit to the total energy measured; the error is greater the smaller the series current. In discussing which is the best combination to use, he states that in practice it is generally necessary to measure a variable current at certain definite potentials, in which case the first combination is much the better, which he shows by an example, in which the error in the second case was 20 times as great as that in the first. Considering next the application to the measurement of sources or generators of energy, the same reasoning applies to the first combination, if the same binding posts be connected to the source that were connected to the receiving apparatus, in which case the shunt circuit will be connected at the farther end of the series coil, so that the shunt coil passes through the series coil. If the current is the principal variable, the error will therefore be reduced to a negligibly small quantity in all practical cases, if the connections are made so that the series coil forms, so to speak, a portion of the apparatus of which or for which the energy is to be measured; the shunt circuit is therefore connected at the beginning or at the end of the series coil, according as the apparatus is the receiver of current or the generator. He believes the ingenious compensating device of Mr. Swinburne (see Digest Oct. 28) is too complicated and increases the heat in the apparatus, which disadvantages more than counterbalances the advantages. In the next section he will discuss the influence of self-induction.

Potentiometer for Alternating Currents.—The Lond. "Elec. Rev.," Feb. 16, in an editorial calls attention to the advantage of using the potentiometer for alternating currents, and refers to a Physical Society paper of Mr. Swinburne describing a method in which a direct pressure is balanced against an alternating one by means of a differential electrometer with single fibre suspension, a zero method being used; an alternating and a direct current are similarly compared by means of a differential dynamometer with the controlling spring removed.

Error in Measuring Coefficients of Induction.—In a Physical Society paper abstracted in "L'Ind. Elec.," Feb. 10, Mr. Abraham calls attention to a cause of errors in these measurements when a turning commutator is used; if the real induction, L, is rather large, its time constant, $L \div R$, is comparable with the period of the commutator, and the total induced current is then no longer obtained, as its duration would be greater than that of the closing of the contacts, and the coefficient of induction would then be too low; this error may be avoided by a sufficient increase in the resistance; this explains why two solenoids on the same iron core seem to have two different coefficients of mutual induction.

Thermometer.—"L'Ind. Elec.," Feb. 10, abstracts a description from an Academy paper of Mr. Barille of a thermometer which indicates by an alarm bell any desired maximum temperature; a good illustration accompanies the description; it consists of an ordinary mercury thermometer, the mercury of which is connected to one end of the circuit; in the space above, which forms the larger part of the thermometer, another wire passing out through the glass is connected to the other pole, but the end in the tube does not reach the mercury; a third wire is loose in the interior and makes a sliding contact with the upper wire; the upper end is fastened to a short iron rod and the lower end makes contact with the mercury; by means of a horseshoe magnet this iron rod, to which the movable wire is attached, can be moved up or down, so that the lower end can be set to any desired mark on the temperature scale; the upper part of the thermometer is filled with a liquid (ortholuidine or ethylorthotoluidine is preferred); the total length is about 17 inches.

Electrical Units.—In an article by Mr. Campbell in the London "Elec.," Feb. 16, he gives a brief description of the practical and the two systems of absolute units, including a table, in which they are represented in terms of each other and distinguished from the usual tables in which their dimensions are given; he shows how those of one system can be converted into those of another, and concludes with a calculation of a magnetomotive force in the two different systems.

Bolometer.—The "Elek. Zeit.," Feb. 8, gives an illustrated description of the iron wire bolometer of Dr. Edelmann for examining heat spectra, based on an instrument devised 20 years ago, which is made more accurate now by the use of the Rosenthal micro-galvanometer.

DYNAMOS AND MOTORS.

A Difference Between Dynamos and Motors.—In an article in the "Elek. Zeit.," Feb. 8, Mr. Baumgardt calls attention to the well-known fact that for the same excitation, armature current and speed the counter E. M. F. of a motor is greater than the E. M. F. when used as a generator; if the Foucault currents and self-induction are great, the loaded motor can even generate a higher counter E. M. F. than when running unloaded. He quotes from a number of well-known authors, some of whom offer explanations; Froelich states that the Foucault currents in the generator weaken the field, while in the motor they strengthen it; Kapp states that the losses due to Foucault currents and hysteresis must be compensated in the motor by an increased voltage, but Baumgardt states that these losses diminish only the torque, and therefore require an increase of the current but not of the voltage. He discusses the various factors systematically, summing them up to obtain the total effect; in the generator the proper position of the brushes is determined by the sum of the influence of the magnetic armature reaction and the influence of self-induction, while in a motor it depends on their difference; in a motor, therefore, the shifting of the brushes is less than that in a generator by double the effect of the self-induction; as the weakening of the magnetic field by the armature increases with the shifting of the brushes nearly proportional to the angle, it follows that in the generator the armature current weakens the field more than in the motor. The magnetic field due to the Foucault currents is less in the generator than in the motor on account of the diminished field, and has the opposite effect on the useful field; in the generator the self-induction diminishes the E. M. F., while in the motor it strengthens the counter E. M. F. The torque on the armature wires in the motor is larger than under the same circumstances in generators, but he states that the torque at the pulley need not therefore be greater. In conclusion, he describes a simple test by means of which the values of these factors can be determined experimentally.

Hollow Magnets for Dynamos.—The "Elek. Zeit.," Feb. 8, contains another article of the interesting series by Mr. Schultz. Referring to the statement made by Prof. Grotrian (see Digest Feb. 17, under "Magnetization of Solid and Hollow Iron Cylinders"; in that abstract the word "higher" near the end should read "lighter") that for weak magnetization only the outer layers of the iron are magnetized, Mr. Schultz describes a series of experiments made with a dynamo of a commercial type, in which the magnetization curves were constructed from actual measurements while running, and in which the fields were afterward bored out with a relatively small hole and then with a large one; in each case he found that the curves differ by precisely the amount that calculation would give in connecting for the diminished cross-section of the iron, even for very low magnetization and remanent magnetism; the cross-section was diminished from 50 square centimetres to 28; the results of

the tests are given. These do not agree with the statement of Prof. Grotrian, which he explains by the fact that the length of the magnets as compared with the diameter was very great in these experiments, while with his dynamo the magnets were, as usual, very short; it follows from this that Prof. Grotrian's results do not apply to dynamos as usually constructed.

Output as a Function of Size.—The "Elek. Zeit.," Feb. 1, contains an article by Mr. Wiener on this subject, in which more data and less formula are given than in his article in The Electrical World, Nov. 18.

Irregularities in the Action of Dynamos.—The translation of the French serial, mentioned before in these columns, is continued in the Lond. "Elec. Rev.," Feb. 16.

Construction and Working of Electromotors.—An elementary paper by Mr. Dykes is reprinted in the Lond. "Elec. Eng.," Feb. 16.

ARC AND INCANDESCENT LIGHTS.

Efficiency of Different Lights.—In an article by Mr. Henry in "La Nature," Feb. 10, chiefly on phosphorescent lights, he gives the following efficiencies, which represent the amounts of the energy which are converted into light as distinguished from heat: Oil lamp, 3 per cent.; ordinary gas burner, 4 per cent; incandescent electric lights, about 6 per cent.; arc lamps, 12 per cent.; magnesium light, 15 per cent.; Geissler tube, about 32 per cent.

Automatic Mercury Pump.—The "Elek. Anz.," Feb. 1, gives an illustrated description of an improvement of Prof. Neesen's vacuum pump, mentioned in the Digest Nov. 18; the improvement consists in an important simplification which obviates the necessity of any connections.

ELECTRIC RAILWAYS.

Heilmann Locomotive.—In "L'Ind. Elec.," Feb. 10, Mr. Hospitalier gives a full and detailed description of this locomotive, together with a table of data and dimensions, and a number of good illustrations, including two full-page views of the finished locomotive. It will be remembered that this locomotive contains a steam boiler, a steam engine, a dynamo and a number of motors; references and results of tests have been given in the Digest May 6, July 22, Oct. 7, Feb. 17; the main object is to obtain softly running movements and an entire absence of alternating motion, to obtain great speeds and great adherence; it has passed through various stages during the past four years, the present arrangement being the one finally adopted. A description by Mr. Heilmann of the principles is quoted at some length; the electric transmission takes the part not only of a true transmission by pulleys, but also of one in which it is possible to obtain any ratio between the diameters of successive pulleys; as the steam engine operates under better conditions than those of ordinary locomotives, the loss due to the double transformation is said to be more than compensated, the efficiency of the whole combination representing a greater economy of coal for the same work done; the adherence is said to be increased very greatly. A detailed description of the different parts is given; the effective horse power at the axles is given as 500; the whole rests on two bogie trucks, each having four axles; the steam engine is specially constructed and is of the compound tandem type; the dynamo generates 1,000 amperes at 400 volts, which is separately excited by a small 20-h. p. dynamo and engine, which, at the same time, lights the train; the gearless motors are of the two-coil, two-pole type, one motor being mounted on each of the eight axles; each motor takes 125 amperes at 400 volts; they are connected directly to the dynamo, without any resistances in circuit, in two groups of four motors, each in parallel; each two groups can be coupled in series or in parallel, and their excitation can be varied; any of the motors can be cut out of circuit separately Besides the results of the tests already published in these columns, it is stated that at a velocity of 33 miles per hour and on an up grade of 3 feet in 1,000 it drew 90 tons, consuming 1,000 amperes at 300 to 350 volts; although very complete measurements were taken during the recent trials, they have not yet been prepared for publication. "La Nature," Feb. 17, contains a briefer description, including almost all of the illustrations. According to "La Nature," Feb. 10, in a recent trial of this locomotive, a train of 90 tons was drawn at a rate of 33 miles an hour up a grade of 8 feet to the thousand and at a velocity of 48 miles an hour up a grade of 3 feet to the thousand; it considers these results quite favorable; a complete description of this locomotive is promised in the next issue of that journal. In a short article by Mr. Lea, in the Lond. "Elec. Eng.," Feb. 16, some illustrations are given, as also a profile of the road over which the trial was made, the length of which is about 16 miles. He states that Mr. Heilmann claims, and quite rightly, that his method enables high speed electric traction to be adopted at once on any line without interfering with the present conditions or necessitating changes in the permanent way, or requiring the erection of generating stations.

Liverpool Overhead Railway.—According to the Lond. "Elec.," Feb. 16, during the past six months passengers were carried at the rate of five million per year; the gross earnings for six months were about $92,000 and the working expenses about $69,000. A report of a recent meeting of the stockholders is given in abstract in the Lond. "Elec. Rev."

Underground Electric Railway in Budapest.—According to the "Elek. Zeit.," Feb. 8, a definite proposition has been made to construct an underground railway about two miles in length; it is not to be tunnelled like the City and South London line, but is to be run directly below the pavement; it is to be ventilated throughout with electric ventilators; it is to be completed before the year 1896.

Steam Tramway.—"La Nature," Feb. 10, gives a well-illustrated description of the steam tramway, in which the Serpollet boiler is used. (The principle of this unique boiler is that the water is heated between two flat surfaces of iron very close together and heated over a fire; it is inexplosive and instantaneous in action, water being pumped into it only at the moment when steam is required.)

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

The Question of the Best Frequency.—In a well-written article by Mr. Kolben in the "Elek. Zeit.," Feb. 8, he discusses in a systematic manner the various different influences of different frequencies, giving in each case simple practical formulas for determining the influences of different frequencies; he divides the subject into three parts: (1) the dependence of hysteresis and Foucault current on the frequency and the resulting effect on the efficiency, heating and cost of construction; (2) the increase of the resistance, the self-induction and capacity of the line with increasing frequency; (3) the influence of the frequency on the parallel coupling of generators and on the running of motors. The results can be indicated only briefly here; the hysteresis loss increases proportionately with the frequency and with the 1.6 power of the maximum induction; the Foucault losses increase with the square of the frequency and with the square of the induction; a series of curves are given, one for each of the frequencies used in practice from 40 to 140, a set of curves being given for the hysteresis losses, for the Foucault losses and for the sum of the two, the ordinates being induction and the abscissas the losses; the results were verified experimentally by the writer by a large number of tests; a similar set is given for the low frequencies occurring in continuous current armatures. From one of these he deduces the induction for various frequencies for a constant

loss of 15 watts per cubic decimetre; from the formula for calculating the cross-section of the iron he shows that it diminishes with the product of the frequency and the induction density; but as the induction need not diminish in the same degree as the frequency increases, an increased frequency results either in a reduction of weight for the same watt losses—that is, the machines are cheaper—or the efficiency is increased with the frequency; aside from this the weight of copper is less, owing to the smaller length of wire; for small machines and transformers whose surface is proportionately great a high frequency is allowable, but for large units, as used in Europe, an increase above 60 is too great and is not rational, as nothing is gained in efficiency and little in weight and cost. Regarding the second division, he states that these considerations are the most important factors, and he divides them into an increase of resistance in large secondary circuits, the self-induction and the capacity of the high tension lines; regarding the first of these he gives the formula showing that the resistance increases with the square of the frequency, a set of curves being given for different values, showing that for 50 periods and for diameters of less than about 3-8 inch this factor can be neglected; but with the frequency used in this country extensive secondary networks are for this reason out of the question, as the increase is quite great; stranded cables do not overcome this; either flat cables or stranded ones, in which the strands are alternately in the middle and on the outside, could be used; he discusses the effect of impedance, giving a set of curves taken from those of Kennelly, and concludes that for large transmissions to long distances frequencies of over 60 are not to be used, but in underground cables self-induction and capacity effects may neutralize each other under certain conditions, for which he gives the relation, showing that in installation there would be only one value for the frequency; regarding the capacity of overhead lines, he states that the effect, even for great distances, is by no means as great as is often stated; the higher the frequency the greater this effect; he gives a formula for calculating the capacity of air lines and the resulting charging current, which he finds increases proportionately with the frequency; for underground rubber cables he also gives a formula, showing that this current is relatively great; he refers to some tests made over a long distance overhead line with 25,000 volts and a frequency of 42, showing a close agreement between calculation and observation of the charging current, the watt loss being less than 1 per cent.; the increase in the transformation ratio of transformers caused by the capacity of the line (Ferranti effect) is due, he claims, to improper construction of the transformers and can be made inappreciable by a proper design. Regarding the parallel coupling of alternators, he says that it cannot be discussed with simple theories, as it depends on a great many factors, but experience has shown that the frequency affects this but little; for instance, in some installations with a low frequency an artificial load is absolutely necessary, while in others with a high frequency it is not required; regarding motors, however, a high frequency increases the difficulty in design, as it increases the number of poles for given speeds, a table of which he gives; for lower speeds the design can be made much better; for a frequency of 50, for instance, the number of poles can be reduced to from 4 to 8 for motors of 1 to 50 h. p., whereas with a frequency of 130 the number of poles would have to be from 10 to 20; as the current for no load increases directly with the number of poles and becomes very great with small motors, this factor becomes the most important one in the designing of motors for high frequency. In conclusion, he states that with the exception of the transmissions of very great powers to unusually great distances, a frequency between 50 and 60 is about the best.

Long and Short Feeders from the Same Dynamo.—In a description of the central station in Suhl in the "Elek. Anz.," Feb. 8, a system is described in which a series machine for 12 volts is coupled in series with one of the pair of feeders leading to a distant centre, the machine being coupled to the main dynamo; it is said to keep the voltage at the distant end quite constant.

Regulations for Steamship Lighting.—Mr. Kennedy begins a series of articles in the Lond. "Elec. Rev.," Feb. 16, in which he suggests rules and regulations for installations on board ship; the first portion is only introductory. In the same issue Mr. Cline suggests a few rules.

Fatal Accident.—The report of Major Cardew to the Board of Trade regarding the death of a horse from connection with a faulty underground main is given in the London journals of Feb. 16.

Steam Turbine Generator.—"Ind. and Iron," Feb. 16, gives a brief description, with good illustrations, of a plant in London in which storage batteries are used in connection with several steam turbine dynamos; the illustrations include a complete diagram of the switchboard, showing the connections for charging and discharging the batteries.

Double Acting Gas Engines.—The Lond. "Elec.," Feb. 16 publishes some correspondence of Mr. Dowson and Mr. McMullen, the latter being in favor of double acting engines.

Double Acting vs. Single Acting Engines.—The Lond. "Elec. Rev.," Feb. 16, contains a long communication from the Willans & Robinson Company in favor of single acting engines.

Direct vs. Rope Driving.—A correspondent to the Lond. "Elec. Rev.," Feb. 16, writes in favor of rope driving.

Motive Power and Gearing.—In Mr. Carter's serial in the London "Elec.," Feb. 16, he discusses thermo-dynamic principles.

Berlin.—The Lond. "Elec.," Feb. 16, gives briefly an abstract of a report of the Berlin stations up to June, 1893. The number of 30-watt lamps rose from 272,000 to 328,000 and the output from 45.9 to 53 million ampere hours; besides what was consumed at the stations the total receipts were nearly $900,000, representing an increase of 8 1-2 per cent. in spite of the reduction in the price; the number of motors increased from 121, representing 500 h. p., to 232, representing 785 h. p., or nearly 60 per cent.; the coal has been reduced 23 per cent., the total decrease being 15.6 per cent. per indicated h. p. hour; the system of regulating clocks from the central station, described some time ago in these columns, is now working satisfactorily; the net earnings were about $272,000.

London.—The first part of Major General Webber's paper is reprinted in the Lond. "Elec.," Feb. 16, in which it is also discussed editorially at some length; it is chiefly of local interest. The paper is continued in the Lond. "Elec. Eng.," and begun in the Lond. "Elec. Rev.," Feb. 16.

The Lond. "Elec. Eng.," Feb. 16, reprints the reports of several London stations, giving tabulated data of the accounts. Several similar reports are given more briefly in the Lond. "Elec. Rev."

Blackpool.—The Lond. "Elec. Eng.," Feb. 16, reprints a paper describing this installation, in which 2,000-volt alternating currents and transformers to feed separate installations or groups are used, together with high tension continuous currents for public arc lighting.

St. Pancras.—The paper describing this station, which was the first that was owned and operated by municipality, is given in full in the Lond. "Elec. Eng." and in abstract in the Lond. "Elec.," Feb. 16.

Huddersfield.—A description of this station, with some good illustrations, is given in London "Lightning," Feb. 1.

Burnley.—An illustrated description of this station is given in London "Lightning," Feb. 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Mileage of Submarine Cables of the World.—A correspondent to the Lond. "Elec." calls attention to a discrepancy of nearly 10,000 miles in the figure given by Mr. Preece, 139,574, and that given in the British Electrical Directory, which is 148,882 for the end of 1892.

Norway Telephones.—The Lond. "Elec.," Feb. 16, publishes a note from the report regarding the taking over of the telephone lines by the state.

ELECTRO-CHEMISTRY.

Plating Aluminium.—In a paper by Dr. Neesen, reprinted in the "Elek. Zeit.," Feb. 8, he describes a simple, cheap and very satisfactory method discovered by himself for successfully plating aluminium with any other metal; it is based on the so-called nascent state of the metal. The object, after being cleaned in hot nitric acid, is dipped into a not too concentrated solution of potassium hydrate, at about the temperature of a warm room, until the evolution of gas begins; it is then removed and rinsed in water but not dried, and while there is still a thin layer of the potash adhering to it, it is placed in the silver or other bath; this process cannot be used for acid baths, and is therefore not applicable to copper sulphate baths, which should be replaced by one that is not acid; aluminium of different makers behaves quite differently in regard to the adhesion of the metal, but in any case it may be plated by first amalgamating it, which is done as follows: After cleaning it, as before, dip it into potassium hydrate until gas evolution begins, and after rinsing, but not drying, it is dipped into a dilute solution of some mercury salt, as 5 grams of chloride of mercury to 1,000 grams of water; the black deposit formed is brushed off and the process may then be repeated and the article plated as described above; the adherence is said to be perfect. This also solves the question of soldering aluminium, which, after plating, can be soldered with soft solder very readily. Aluminium may also be plated without a current if treated as described; it may be silver plated by simply dipping into a cyanide bath after treating as described; it may be readily amalgamated as described above; this also is an exceedingly delicate test for the presence of mercury; the process is patented in Germany. In the discussion which followed Dr. Coehn stated that he had obtained good results in plating aluminium in a solution of copper chloride in alcohol. Mr. Huhnholz mentioned, but did not describe, a newly discovered process of tinning or galvanizing aluminium very successfully; the tinning admits of its being burnished and the parts can be soldered or plated like other metals.

Silver Plating Industry.—The serial in "Ind. and Iron" is continued in the issue of Feb. 16.

Electrolysis of Alkaline Salts.—Mr. Nourrison, in an Academy paper abstracted in "L'Ind. Elec.," Feb. 10, calculates the minimum E. M. F. necessary for the electrolysis of soluble alkaline salts and gives an experimental verification; for chloride of sodium it is 2.02 volts, assuming that no work other than that of electrolysis is performed; for sulphate of sodium he obtains 2.15 volts and for nitrate and chlorate of sodium 2.7 volts; for potassium compounds the figures are the same; he concludes that the minimum E. M. F. of an alkaline soluble salt is constant for all the oxysalts, as also for the haloid salts derived from the same acid.

Caustic Soda and Chlorine.—According to the Lond. "Elec.," Feb. 16, the company at Snodland has concluded that the best material for anodes is gas retort carbon, the terminals for which are made of lead, which, however, does not dip into the solution.

Electrolysis of Fused Salts.—In Mr. Andreoli's article in "Ind. and Iron," Feb. 16, he continues the summary of the work which has been done in this field.

Phases and Conditions of Chemical Change.—The "Phil. Mag.," for February contains a long article by Mr. Veley, a brief abstract of which is given in the London "Elec.," Feb. 16; he discusses what the chemical change is and what the cause of its commencement is; he does not favor the theory that chemical changes are due to electrolysis.

Chemistry and Electricity.—An editorial on this subject in the Lond. "Elec. Rev.," Feb. 16, calls attention to the importance of chemistry and recommends its study to the electrical student, stating that a thorough knowledge of chemistry will be of the utmost value to the electrician.

Effect of Polarization Upon Thin Partitions.—The Lond. "Elec. Rev.," Feb. 16, contains an editorial on this subject.

Striated Deposits.—An abstract of an article by Mr. Behn in the "Elek. Zeit.," Feb. 8, discusses the vertical striations noticed when silver and other metals are deposited from a bath; he believes that the explanation lies in the different current densities due to changes in the concentration; the striations are shown best in concentrated nitrate of silver with weak currents and increased temperature; an increased E. M. F. has no effect.

MISCELLANEOUS.

Ozone.—In "Ind. and Iron," Feb. 16, Mr. Andreoli criticises very unfavorably the statement of Mr. Christmas (see Digest Feb. 10). He claims that the statements are inaccurate and that the experiments are misleading and not conclusive; he quotes from a report by Dr. Ohlmueller on "Influence of Ozone on Bacteria," published in the proceedings of the Imperial German Sanitary Board, in which it is stated that anthrax, typhus, cholera bacilli, as well as anthrax spores are destroyed in a few minutes by ozone (but with what degree of dilution is not stated); he also refers to a successful treatment of tuberculosis by ozone.

English Patent Office.—The Lond. "Elec. Rev.," Feb. 16, contains a humorous article by "Moonshine," intended to ridicule the English Patent Office system.

A Storage Battery Competition.

The Electric Storage Battery Company, of Philadelphia, offers to place in the hands of Houston & Kennelly, electrical experts, a chloride accumulator for competitive test against any others that may be offered. The conditions are that each competitor is to deposit $500, and in every case in which the chloride accumulator does not prove at least 50 per cent. better in efficiency, capacity and durability the entire deposit of $1,000 is to go to the other competitor, the Electric Storage Battery Company to be awarded that amount if its battery shows an excess of 50 per cent. of superiority in these three respects. In order that the tests may be of the greatest practical value, it is suggested that a small cell suitable for traction or other purposes, weighing about 50 pounds, and a larger cell, suitable for central station work and weighing from 500 to 1,000 pounds, be entered, although the challenger offers to meet the weight of any element entered.

Messrs. Houston & Kennelly have agreed to make the above tests on the following conditions:

1. All results to be published. 2. Each contestant to be permitted to have one representative present at the firm's laboratory during the tests. 3. Each contestant to be permitted, through his representative, to withdraw his battery at any time, but in all such cases the tests will be published up to the point of withdrawal, and the deposit will be forfeited to the opponent. 4. No tests will be commenced until after the battery has been discharged 100 times at a rate of ¾ of an ampere per pound of electrode as shipped. 5. The tests to be of three kinds, namely, efficiency tests, capacity tests and durability tests. 6. the efficiency to be the ratio of output to intake, and to be measured in watt hours for energy capacity, and in ampere hours for current

storage capacity. The battery to be considered as discharged when the E. M. F. per cell, on opening the circuit, falls below 1.75 volts. The criterion of full charge to be agreed upon in writing before the tests commence in each case. 7. The current capacity to be determined in ampere hours' output from the point of full charge to E. M. F. of 1.75 volts, as above, and to be rated in capacity per pound weight of charged cell and per pound weight of dry electrodes as shipped. 8. The above tests to be made at varying rates of discharge per pound weight of dry electrodes as shipped, in order to determine the range of efficiency and capacity at varying outputs. In deciding the relative merits of two competing cells whose efficiency or capacity may be equal at different rates of discharge, the award will be given to the cell possessing the greater efficiency at the higher rate of discharge per pound of plate weight as above. 9. The durability tests to be made on the completion of the preceding tests and to be under conditions no more severe than those required for traction work. The durability will be measured by determining the number of working hours of charging and discharging at the rate of 2½ amperes per pound of dry electrodes as shipped, which will reduce the storage capacity of the battery in ampere hours to one-half of its first valuation at that output. 10. The award will be made on the basis of the sum of the percentages of the chloride accumulator over contesting batteries on the three claims of efficiency, capacity and durability. The mean efficiency of energy and current and the capacity in ampere hours of battery and electrodes being selected as the relative competitive efficiency and capacity in each case. The efficiency, capacity and durability of the contesting cells will then be divided into the corresponding efficiency, capacity and durability of chloride cell, and if the sum of the three quotients exceeds three and one-half, i. e., 350 per cent. minus 300 per cent., the decision will be given in favor of the chloride cell, but not otherwise.

Electric Heat from Isolated Plants.

The use of electricity, generated by isolated plants for electric lighting, may be extended to a number of commercial processes, which are employed in nearly every form of industrial work in connection with high temperatures, and we are indebted to the Central Electric Heating Company, 26 Cortlandt street, New York, for the following useful information on the subject:

The well equipped manufactory of to-day has its own electric lighting plant; the investment in lighting apparatus is productive capital for a very small part of the time—entirely idle for several months in the summer and productive during the winter for only about three hours per day, on an average. In such cases the current can be used for industrial purposes and the cost of producing the energy can be set down as not materially greater than the number of pounds of coal burned to secure the H. P. H. For instance, if three pounds of coal are burned per H. P. H., at a cost of $5 per ton, the rate would be three-quarters of a cent per H. P. H. All coal is burned under the boiler in the boiler room, and the dirt and the discomfort are confined there.

In all fabric, as well as in other textile industries, the use of electricity for heating sad irons and similar devices offers a means for securing constant working apparatus, together with uniform temperature; and the temperature to which the heated surface is raised may be predetermined, so that little or no loss may occur from the carelessness of the employee in scorching goods.

A 7-pound electric laundry iron requires about 330 watts, so that, including a 10 per cent. loss in transmission, two irons may be run per horse power, or one iron may be run at a cost of only about three-eighths of a cent per hour. Not only can the iron be successfully operated at this low cost, but the employees' time be made more productive. From continuous working and constant temperature of working surface the work is uniform in quality and the loss and damage from overheated irons entirely eliminated.

The mean temperature of the workroom is reduced, there are no injurious products of combustion, the shop can be kept cleaner, the surface of the iron clean and brightly polished. For factory work, no more desirable distribution of fuel can be conceived than electricity for fuel purposes, especially in those operations where the heat is localized, and in nearly every process where high temperatures are required localized heat is wanted.

In the equipment of rubber goods factories or brush factories, or any factories where with present methods flame is used, electric heaters can be used for heating the pitch kettles, glue pots, irons, etc., so that no flame is required in any part of the factory. In a brush factory equipment recently installed, the pitch kettles are heated by heaters immersed in the pitch. Every unit of heat is utilized, and the hottest surface brought 1-2 inch from working surface of pitch. The heating mechanism is arranged for three working heats; a large amount of heat for heating the pitch from the cold; a moderate amount of heat for use when the surface of the pitch is being constantly agitated; a small amount of heat for maintaining temperature when the pitch is not being used. In this equipment the cost of the horse power hour has been determined as c.9 cent; each kettle uses 275 watts on working heat, so that the cost per hour per kettle is about one-third of a cent. There is absolute safety from fire, and from the underwriters' standpoint the electrical distribution of energy for fuel purposes is as great a boon as the use of electricity for lighting has proved to be.

In the manufacture of varnishes, electricity can be used diffused over a constant temperature working surface to melt the gums; and here, as in a number of chemical processes where hydro-carbons are used, the melting point is so near that of heat of decomposition of some of the constituents that a uniformly diffused heat has to be employed, and by using electricity at constant potential absolutely constant working temperatures are secured. By this means cheaper grade materials produce as good results as more expensive gums heated in the ordinary way.

In hospitals electrically heated apparatus can be successfully applied to many processes: for heating food, etc., in the various wards, warming of bandages, beds, etc., and in the laundries, kitchens, etc.

On steamships the dynamos are generally run during the whole day to light the hold, engine and fire room and other dark places, and the various applications for heating purposes are made at the cost per horse power hour of the coal consumption.

In hotels there is probably the widest field for the development of the isolated plants in electric heat engineering. The kitchen of the average hotel contains long, red-hot ranges, charcoal broilers and great unwieldly ovens. The fuel is used inefficiently and accompanied by dirt, unequal fires, stifling, radiant heat, etc. By burning all the fuel under the boiler, using localized electric heat in ovens of small heat capacity, in broilers of high constant working temperatures, in griddles, grease kettles, etc.; in short, for all purposes requiring temperatures over that of live steam. The objectionable elements in present methods are eliminated, labor saved and apparatus introduced that renders the employment of expensive chefs unnecessary.

The efficiency of fuel in hotel work will be greatly increased when the concentrated heats from electricity are used for the high temperatures, live steam for all water boiling processes and exhaust steam for warming purposes, such as steam tables, coffee urns, plate warmers, etc.

In isolated plant work it may be stated generally that the cost of the electrical power can be figured at the cost of coal burned to secure this power; that for concentrated heat the energy can be used successfully and economically; that for fire risk, it is as important a change as that wrought by electric lighting as compared with other methods of illumination. Electric lighting is highly localized electric heating, and the two are directly comparable. Properly introduced and used, the working range of money invested for lighting will serve a number of useful mechanical processes at high temperatures and small heat capacity.

Composite Graphite and Copper Woven Wire Brushes.

We illustrate a new woven wire and graphite commutator brush, made by the Belknap Motor Company, Portland,

COMPOSITE WOVEN WIRE BRUSH.

Me. These brushes contain all the essential qualities of both copper and carbon, and avoid sparking at the commutator; the graphite acts as a lubricant, and the copper as a conductor. It is a well known fact that carbon offers a very high resistance, or 1,500 times as great as that of copper, but notwithstanding this it is used very extensively. By continual experimenting in the use of all kinds of brushes in connection with its machines, the manufacturers found nothing equal to the brush they are now making, which is being adopted by street railway, electric light and power stations in all parts of the country, and the same favorable report is received from them all. While the first cost is some higher than plain copper, the length of life of both brush and commutator more than makes up the difference, so they are much more economical than any others. The brush, being flexible, gives a good contact.

Improved Magneto Telephone.

We give an illustration herewith of a new and improved magneto telephone now being manufactured by the Western Telephone Construction Company, of Chicago. The transmitters are wound in series, and the receivers in multiple arc. This gives an increased potential in the transmitter and decreased resistance in receiver, with the result that it affords an intense magnetic field, and a wide diaphragm. The mass of metal employed is very large, giving increased magnetic saturation and great lasting powers.

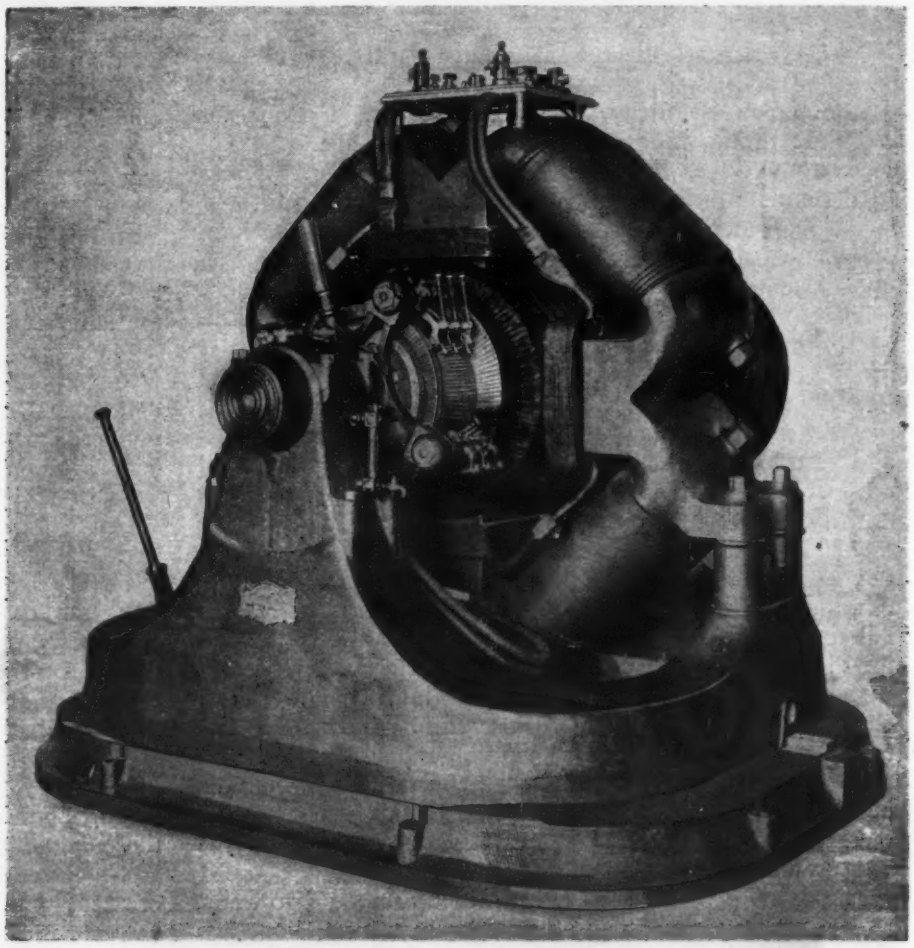
The generator which rings the signal bell generates a current that strengthens the magnets of the instruments so that with every call the telephone is brought up to the point of highest magnetic action.

A recent test was made of two Western telephone instruments between Chicago and New York, and proved a thorough success, the voice being perfectly clear and distinct. Clearness of vocal sound, simplicity of adjustment and economy of maintenance are the points of merit which are claimed for the instrument.

IMPROVED MAGNETO TELEPHONE.

A New Multipolar Generator.

The latest type of multipolar, direct current generator which the Standard Electric Company has placed on the market is shown in the accompanying illustration, and is certain to achieve the popularity which the other types of machines manufactured by this company have attained.



NEW MULTIPOLAR GENERATOR.

The machine is of a solid and substantial design, with large base, insuring rigidity and freedom from vibration. The field has four consequent poles, the wrought iron cores being bolted between soft cast iron pole pieces. The two horizontal pole pieces have two lugs each, and by them the field magnet frame is bolted to the base, a zinc distance piece being interposed at each side to prevent magnetic leakage to the bed plate.

The journal seats are bored in line with the armature bore, and the journal supports being turned in a lathe to a corresponding arc, absolute alignment of the shaft with centre

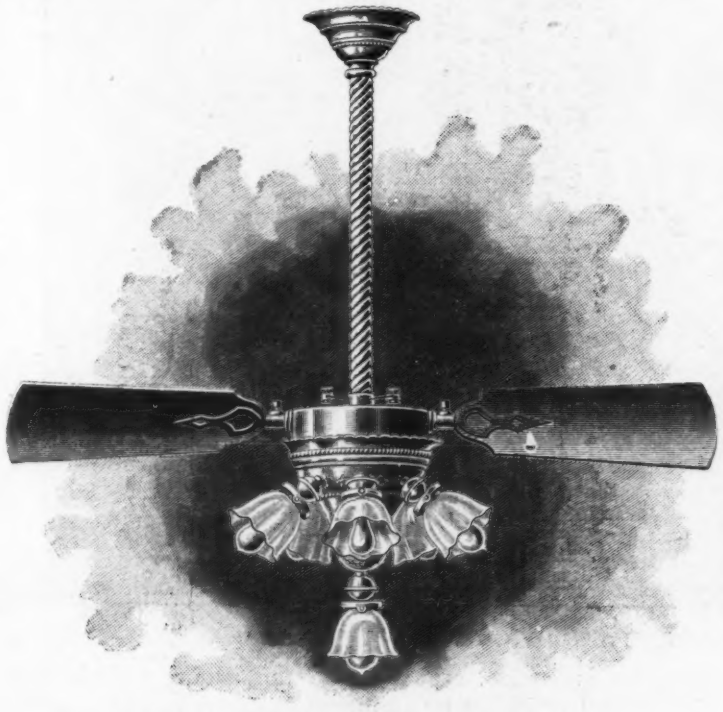
of field bore is assured. The journals are self-oiling, two loose rings being provided for carrying the oil from a reservoir to the shaft. The journals are self-adjusting, being of the universal ball bearing type, allowing the armature shaft to to have all necessary adjustment at all times. By removing a pedestal at either side of the machine the armature can be easily and quickly taken out for inspection or cleaning.

The armature is of the conventional Gramme ring type, but has several important modifications in its details, securing better insulation and absolute stability of the armature conductors. The soft iron armature rings are supported by a split gun metal spider.

The mechanical construction of the commutator is such as to enable any intelligent mechanic to renew any defective segments, or even replace the entire commutator in a comparatively short time.

A neat and substantial switchboard of slate or marble is supported over the two upper fields, and incidentally quite an ingenious use is made of the well-known property of a magnet to repel an arc. The two main line fuses are located almost directly over the ends of the upper fields, and the result is that in case a fuse is blown from any cause, all dangerous arcing is prevented, owing to the repelling action of the pole piece underneath the switchboard.

The brush holders are of a novel and neat design, short blocks of carbon being clamped firmly between two metal jaws, thereby giving a minimum resistance to the brush proper and securing perfect contact with the commutator. In the 125-h. p. machine five brushes, each 1 3-4 inches wide, are used on each brush holder stud, the current allowed in the commutator being as low as 200 amperes per square inch. The two sets of brushes of the same polarity are connected together by two double connecting bars, no cross connections in the armature itself being used.



COMBINED EECTROLIER AND FAN.

The base is arranged so that a pawl and ratchet may be applied to either end, and in case it is desired to reverse the direction of rotation of the armature, no change in the connections is required, the simple reversing of the brushes and bringing them into the opposite neutral plane, respectively, being all that is necessary.

The Standard Electric Company will soon have a complete line of these machines on the market of 110, 220 or 500 volts.

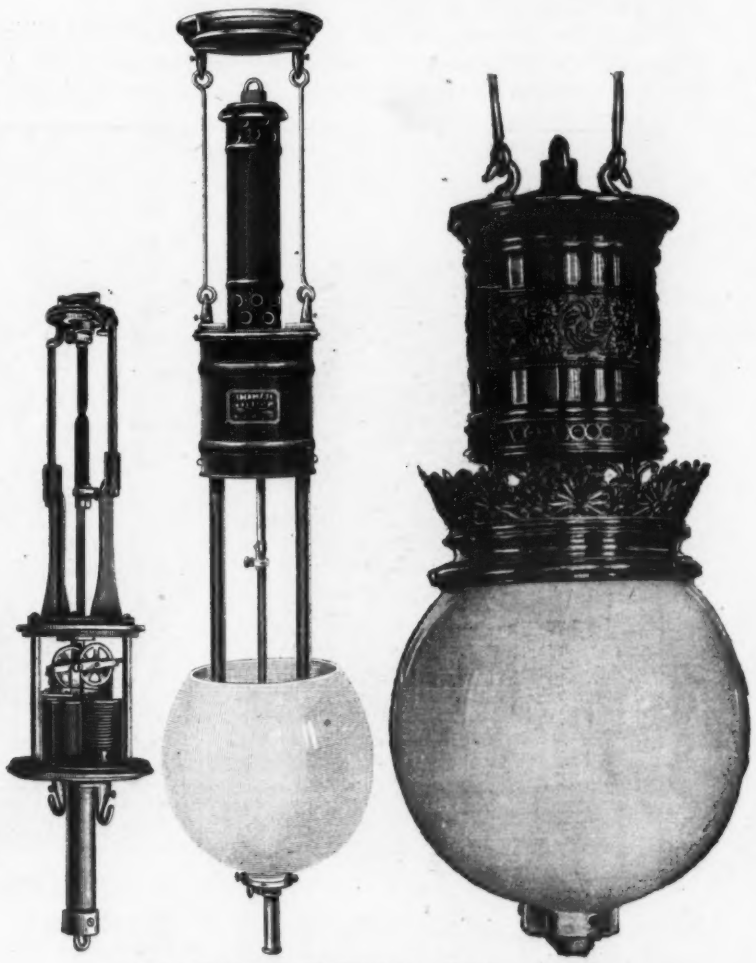
A Combined Electrolier and Fan.

The accompanying illustration shows the "Diehl" electrolier fan, combining with the popular "Diehl" electric ceiling fan a ligthing fixture as well. It is of handsome design and finish, and both the fan and lights can be operated separately or together at will. Diehl & Co., 385 Broadway, are entering the coming season with full lines of other fan devices, and with increased factory facilities.

A New Arc Lamp for Incandescent and Railway Circuits.

That arc lamps capable of being satisfactorily operated on the ordinary incandescent or railway circuits are a necessity is evidenced by the extraordinary demand for them, which seems to have arisen in a surprisingly short space of time. They have been especially advantageous for use in the lighting of interiors of large halls, stores, etc., already wired for the incandescent light.

The General Electric Company announces a new arc lamp for incandescent and railway constant potential circuits. This lamp is known as the Thomson '93 arc lamp, and is the adaptation of a principle and construction patented some years ago by Prof. Elihu Thomson. It possesses characteristics of excellence not found in any other lamp hitherto brought out for constant potential circuits, the most striking of which are the following:



CONSTANT POTENTIAL ARC LAMPS.

The lamp is constructed of but very few parts; it has no delicate mechanism with its attendant constant liability to get out of order, and the parts are practically interchangeable in all the lamps. The motion of the carbon rod either up or down is entirely free; this allows of a rapid and accurate change of carbons, and the usual rough handling incident to this process cannot injure the mechanism. In the ordinary type of lamps the motion of the rod, in one direction at least,

is restricted to slow speed, even with the application of force. As force must be employed in order that the trimmer do his work rapidly, the life of the mechanism in the ordinary lamp is necessarily shortened.

The Thomson '93 arc lamp is a geared lamp, but has none of the disadvantages of either the clutch or clockwork feed mechanism, while possessing all the advantages of a clutch lamp. The feeding of the lamp is entirely independent of the weight of the carbon, it being equally regular whether with a whole carbon or one partly consumed. The lamp burns a very steady arc, noticeably free from noise, and instantly adjusts itself to any variation of potential. The principle of the feed mechanism is that of the rack rod, which carries the upper carbon holder. This rod is of rectangular section; the rack meshes into the teeth of a pinion on an arbor in the case. This arbor also carries a gear which engages with the second pinion on the controlling arbor. Any downward movement of the rack rod and carbon is regulated by a pawl and rachet wheel on the second arbor. The pawl is controlled by the shunt magnet of the lamp, and the design is such as to permit a single tooth only to pass at one movement. The movements can, however, follow each other so rapidly as to allow a practically continuous feed until the proper length of arc is obtained. The series magnet in the lamp acts to draw and maintain the arc.

The lamps are adjusted for nine amperes of current with a 45-volt arc, but can be furnished for any current from 4 amperes upward on special order. As with any arc lamp, the best results can be obtained by the use of first quality cored carbons, but the Thomson '93 lamp will give better results with ordinary commercial carbon than any other arc lamp at present before the public.

At present four varieties of this lamp have been designed by the General Electric Company, and are now ready for delivery; that for the alternating current is nearly completed. The varieties alluded to are as follows:

The long lamp for incandescent circuits is of plain design and intended for out-of-door circuits, to be used two in series on 110-volt lines. The necessary resistance is placed in the chimney and external rheostat is unnecessary. The total length of this lamp is but 49 inches.

The short lamp, for incandescent circuits, 32 inches long, also of plain design, is intended for indoor use. A separate rheostat is here necessary.

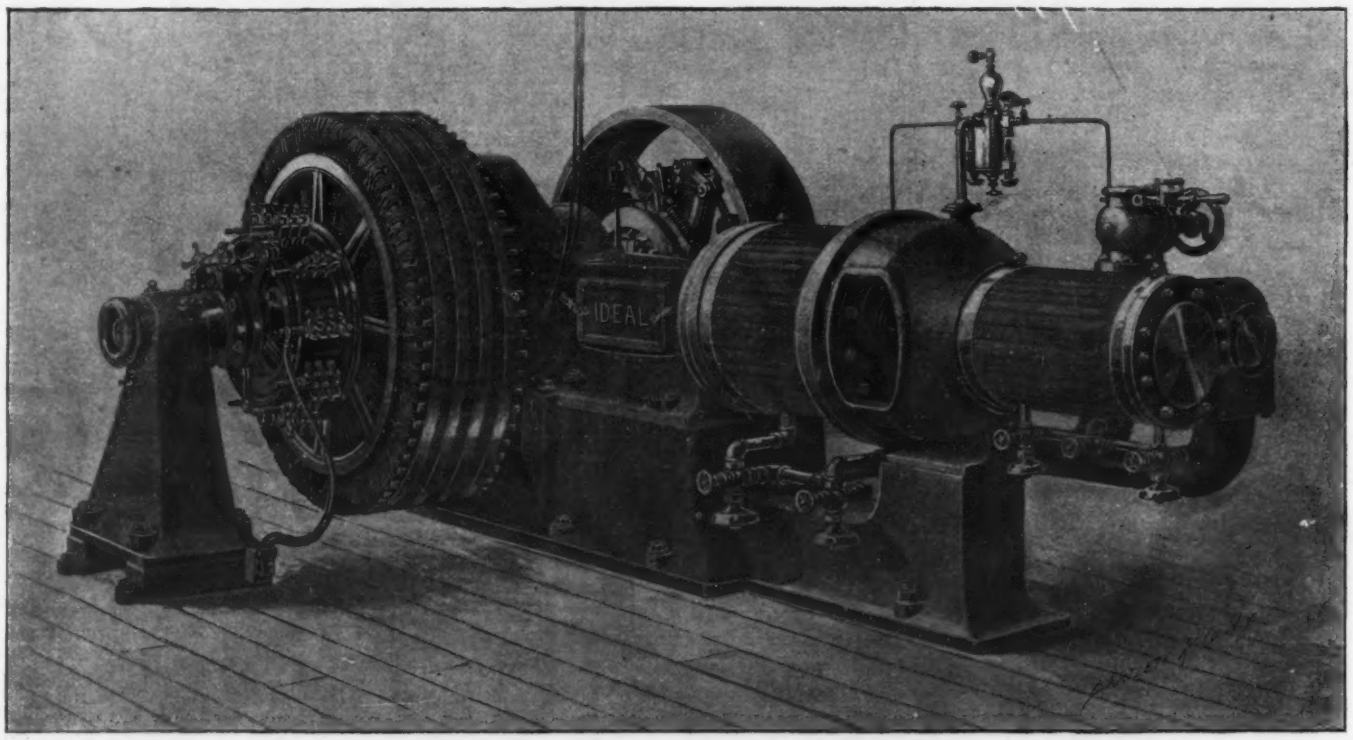
The long lamp, for use on 500-volt railway circuits, designed to be run ten in series, with a rheostat. nished free of charge with each set of ten lamps ordered. In external appearance this lamp is like the long lamp for incandescent circuits, but the resistance in the chimney is replaced by a cut-out thrown into circuit when the carbons burn out or the arc is accidentally extinguished.

The ornamental lamp has a still shorter frame than the short, plain lamps, and the globe is supported from the top on the side of the rods.

The focusing lamp, the smallest practical arc lamp on the market, being but 23 inches long, is designed for indoor use only. The globe is held from the top, as in the short ornamental lamps, and as the carbons are consumed the arc maintains the same position in the globe, owing to the movement of the carbon rods.

Direct-Connected "Ideal" Engines.

The direct connected combination of engine and dynamo of to-day is demonstrating, by an increasing number of plants, its practicability, efficiency and sound principles. We illustrate herewith one of the most modern of these dynamo engine combinations yet produced. This comprises a multipolar dynamo of the Waddell-Entz type, driven by a Harrisburg tandem compound Ideal self-oiling engine. The



DIRECT-CONNECTED ENGINE AND DYNAMO.

dynamo is 80 kw. capacity, and the engine cylinders 10 inches and 17 inches by 12 inches, built for running, in this instance, non-condensing. The speed of the combination is 260 revolutions per minute, and it operates under a pressure of 115 to 125 pounds.

The Ideal engine has several strong points of improvement, as compared with what has heretofore been considered "good enough" practice. The self-oiling feature is shown to be a highly efficient device, all the bearing surfaces being, by its use, supplied with continuous streams of oil, by which the following very apparent advantages are obtained: First, perfect circulation of oil without the care and attention dependent on drop feed and other devices for oiling; second, important bearing surfaces are dust proof; third,

there is freedom from all splashing and unsightly dripping of oil on the floor and dynamos.

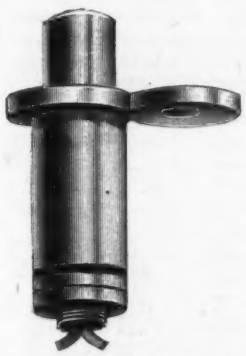
In direct connected work it is extremely important that the dynamo should be kept as free from oil as possible, for the short circuits of dynamos are most frequently traced to the throwing or conveying of oil from the engine to the dynamo. The simplicity and heaviness of the machine is noticed, and the method of support under the cylinders is well designed.

The economy of this combination is quite remarkable, since a water consumption is claimed in service of 23 pounds per horse power per hour, non-condensing.

The Ideal engine is the product of the Harrisburg Foundry and Machine Works, of Harrisburg, Pa., and was ordered and installed at the Bridgeport Copper Company by its representatives for New York and Boston, W. R. Fleming & Co., 203 Broadway, New York, and 620 Atlantic avenue, Boston.

Improved Door Spring.

Heretofore springs of this kind have been very ineffective owing to the imperfect connection made by a straight pin or flat contact, but in this spring this is overcome by slitting the wire and bending out the ends, as shown by cut, thereby making a taper, rubbing and positive contact.

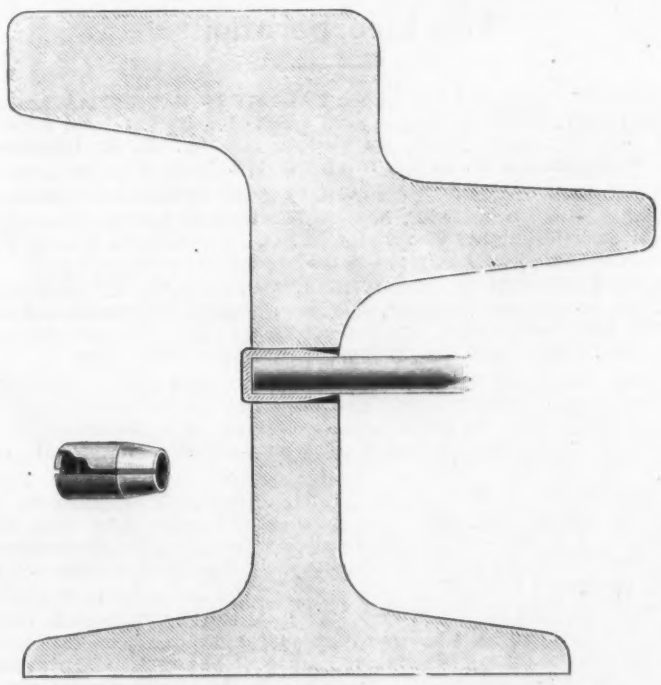


DOOR SPRING.

Owing to the small size, this spring can also be used on inside blinds, etc. This spring is made by Huebel & Manger, manufacturers of electrical goods, 286-290 Graham street, Brooklyn, N. Y. The work and material is of excellent quality, and the spring will undoubtedly prove popular.

Steel Bonding Caps.

The accompanying cut shows views of the new track bonding device recently brought out by the Ohio Brass Company, of Mansfield, Ohio. The steel bonding cap, as its name signifies, is a steel cap, which fits snugly over the end of the bonding wire and into the web or flange of the rail. The method of bonding tracks with this cap is as follows:

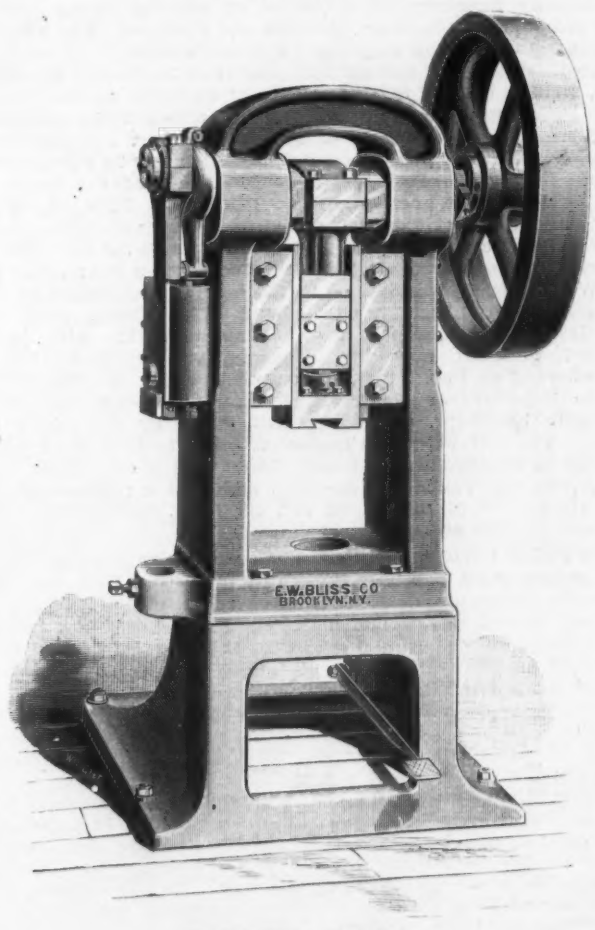


TRACK BONDING DEVICE.

The end of the wire is passed through the hole in the rail, which is drilled 1-32 of an inch smaller than the outside diameter of the cap. The cap is then placed on the bonding wire and entered into the rail. A few blows from a hammer fasten it in place. The crimp extending the full length of the cap allows the shell to compress firmly over the wire and into the rail, making a perfect air and moisture proof joint. It can be used equally well with iron and copper wires of different sizes. The facility and quickness of bonding will no doubt bring it into favor.

Trimming Press.

We illustrate a press of late design brought out by the E. W. Bliss Company, Brooklyn, N. Y., intended for use in the forge shop where hot metal is to be trimmed. It was the intention of the designers to build a press that would meet as nearly as possible all the requirements for which a press of this class of work can be used. The press is fitted with the well known Bliss clutch and a patented adjustment in the slide, and has a supplementary slide in the side of its frame to be used in cutting off the work from the bar after it is forged and trimmed. This is considered a new feature in a press of this kind, and will be at once appreciated by persons using such machines. The construction of the machine is very strong, and every detail has been carefully studied. These presses are built in several sizes and are usually made with fly wheels, as forgings are usually required to be trimmed very quickly, and a high speed machine becomes necessary. This cut represents a press with a 4-inch stroke, 4-inch adjustment and 15 inches from bed to end of sdile when up; the distance between uprights is 22 inches. This machine caries a 900-pound flywheel, the total weight being about 5,500 pounds. The dimensions can be modified to suit special requirements, if it is necessary. These presses can also be geared for cold trimming.



TRIMMING PRESS.

Financial Intelligence.

The Electrical Stock Market.

New York, March 3, 1894.

ELECTRICAL STOCKS have again come to the fore—General Electric, Western Union, Bell Telephone and Westinghouse serving to add not a little to the activity of this week's New York and Boston markets.

GENERAL ELECTRIC has scored a most substantial rise this week, the gain being 3 points. Insiders have been open in their expressions of bullishness, and, while admitting the poor character of last year's business, have made most cheerful predictions regarding future business. They base their hopes of prosperity on the extent to which the business of the General Electric Company has improved of late. The main buying of the stock has been for the account of a Broad street house with large foreign connections. Some time ago a request was made by this house for a statement of the company's condition and prospects for the benefit of foreign stockholders, and the information furnished was of so pleasing a nature that the foreign investments have been largely added to this week. It was pointed out to this house that the company is practically out of debt, the only obligation being endorsements on about $1,000,000 of customers' notes discounted by the company; that collections have improved immensely, and that the general resources of the property have now been so much bettered that a dividend will soon be earned on the preferred stock. In fact, it is now stated that, while the dividend on the preferred will, for prudential reasons, be postponed at the coming directors' meeting, the full amount will be paid during the present year, thus paving the way for a resumption of dividends on the common stock. It is very easy, of course, to figure in this way, but less than $1,600,000. This would allow the payment of the interest on the debenture bonds, 7 per cent. dividends on the preferred stock, as well as the accumulated dividend on the same, about $150,000, and leave $650,000, or about 2 per cent. on the common stock. It is very easy, of course, to figure in this way, but the stockholders will soon have to face the appalling showing that the coming annual report will make. The falling off in business from Feb. 1, 1893, to Feb. 1, 1894, has been tremendous; where the company formerly did $15,000,000 of manufacturing business it last year did only between $7,000,000 and $8,000,000. The directors, it is understood, intend to present a direct statement of what has happened. They will make a full exhibit of the losses, scaling off assets, writing off and marking down of accounts during the past year. President Coffin and Director Twombley unite in denying that there will be a deficit of several millions, and that some plan will be devised to reduce the capital stock to represent the decrease in assets. It is nevertheless true that the assets behind the stock have greatly shrunken in value. First of all, over $12,000,000 of the best treasury securities were handed over to the Street Railway and Illuminating Securities Trust for $4,250,000, and the assets left over are not half as valuable as a year ago. Thus Fort Wayne stock was figured in the last annual report at $12.50 a share; to-day it is worth about $5 a share. And other securities have suffered in like manner. It will be interesting to read how the directors will explain the fact that, whereas on Feb. 1 last, the company had a surplus over immediate liabilities of about $25,000,000, six months later it was practically bankrupt, and at present is hardly out of its difficulties. The advent of the annual meeting revives the report of a change in management. Gossip has it that much of this week's buying was for Vanderbilt account, and that a representative of that interest, in all likelihood Mr. H. McK. Twombley, will be President Coffin's successor.

WESTERN UNION TELEGRAPH, as was anticipated in these columns last week, has been put up by insiders. It is now understood that at the directors' meeting on the 14th inst. the full dividend will be declared. Knowledge of this has caused a scramble among shorts to cover, and added to this has been good buying for Gould interests. It is thought that the quarterly statement, soon to be presented, will show net results equal to nearly 1½ per cent. upon the $100,000,000 capital stock. How much faith insiders have in the property is demonstrated by the following remarks of Mr. Russell Sage: "The property is in excellent condition. We have spent a great deal of money on it, and look for better returns during the next six months than we have had in the past six months. When comparison is made with the spring statement, it will be found that notwithstanding the depression caused by the panics, the growth of the country has more than kept pace with the falling off in business. In other words, $1,500,000 net would have been considered monumental a couple of years back. Western Union is a good property; one that is not likely to decline much, but will be sought after by investors, who will be satisfied to buy it and hold it for the dividends that it yields, and for the future rturns that it will make."

WESTINGHOUSE ELECTRIC'S strength is again the subject of much favorable comment. It has been due to the bright business prospects. January net earnings alone are now estimated at between $125,000 and $150,000. The current fiscal year ends with this month, and the annual report is expected to show a net income of upwards of $1,800,000, or about 20 per cent. on the stock. Negotiations for several important contracts are now in progress, with every indication of a successful outcome. The directors declare this week a quarterly dividend of 1¾ per cent. on the preferred stock, payable April 2.

BELL TELEPHONE stock has been weaker. The legislative attacks on telephone rates in New York and Massachusetts, together with the now published fact that future issues of stock will probably carry no subscription rights, have served to depress the price. The hearing on the petition for an increase of the capital stock has been postponed until the 7th inst. The statement of instrument output shows how the times affect this company. From Dec. 21 to Feb. 20 there was a gross output of 9,733, but 13,248 instruments were returned, leaving a deficit of 3,515. This compares with a net output in the preceding year of 4,852, a falling off of 8,367. The total number of instruments in use on Feb. 20, 1894, however, was larger than a year ago, being 564,482, against 556,591, a gain of 7,891 instruments.

THE UNITED ELECTRIC SECURITIES COMPANY invites proposals for the sale to the company of $120,000 of its collateral trust 5 per cent. bonds. A balance sheet, as of Feb. 1, just issued, shows: Assets—Stock, $1,853,200; bonds, $290,750; accounts receivable, $58,452; notes receivable, $41,763; total, $2,244,166, but market value only $1,000,000; $6,627,000 underly first mortgage bonds deposited to secure collateral trust 5s, less 20 per cent. reserve, $5,301,600; accrued interest, $98,265; cash on hand, $37,916; total $6,437,781. Liabilities—Capital stock, common, $500,000; preferred, $1,000,000; collateral trust 5 per cent. bonds, $4,884,000; surplus, $53,781; total, $6,437,781. The company recently cut down its capital stock from $1,000,000, of which the General Electric had over $800,000, to $500,000, to make up for the shrinkage in assets.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	35
Detroit Electrical Works	10	3	8
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	93	98
" " " 1sts	—	105⅝	105¾
Edison Electric Ill., Brooklyn	100	100	101
" " " Boston	100	112	115
" " " Chicago	100	145	150
" " " Philadelphia	100	115	120
Edison Electric Light of Europe	—	—	3
" Bonds	—	80	85
" Ore Milling	—	5	11
Fort Wayne Electric	—	4½	6½
General Electric Company	100	41¼	41½
" " " deb. 5's	—	80	81¼
Interior Conduit and Ins. Co	100	20	30
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	45	47
" " " pref.	50	20½	27½
Western Union Telegraph	—	85½	85⅝
American Bell Telephone	—	168	169

New Incorporations.

THE SHAMOKIN AND BEAR VALLEY ELECTRIC RAILWAY COMPANY, Sunbury, Pa., capital stock $100,000, has been formed to construct and operate an electric railway. E. C. Hamilton, G. W. Smith and W. H. Ker are interested.

THE BASTRON WATER AND LIGHT COMPANY, Bastron, Tex., capital stock $40,000, has been formed to furnish the public with electrical lights and water. P. O. Elener, T. A. Hasler and Louis Ellers, all of Bastron, are the promoters.

THE LARCHMONT ELECTRIC LIGHT COMPANY, Larchmont, N. Y., capital stock $15,000, has been formed to furnish electric light, heat and power. The promoters are C. H. Murray, William Murray, Larchmont Manor, and F. G. Seuter, New York.

THE MEREDITH ELECTRIC LIGHT COMPANY, Meredith, N. H., capital stock $6,000, has been formed to furnish electric light and power. A. W. Ives, Boston, Mass.; E. C. Mansfield, G. T. Sanborn, A. A. Kidder and J. S. Wadleigh, Meredith, N. H., are the promoters.

THE EAST BUFFALO ELECTRIC COMPANY, Buffalo, N. Y., capital stock $1,000, has been formed to supply light, heat and power. J. J. Churchyard, 221 Summer street; Stephen Churchyard, 129 Munroe street, and S. A. Simons, 54 Irving Place, Buffalo, N. Y., are interested parties.

THE R. HAAS ELECTRIC AND MANUFACTURING COMPANY, Springfield, Ill., capital stock $10,000, has been formed to manufacture electric appliances and to do a general electric business. Rudolph Haas, E. C. Haas and W. L. Blucke are interested parties.

THE SUBURBAN ELECTRIC LIGHT AND POWER COMPANY, Chicago, Ill., capital stock $15,000, has been formed to manufacture and sell electricity for light, heat and power. A. F. Dexter, William Phillipson and M. Gorton Carr are the interested parties.

THE SUPERIOR LIGHT, HEAT AND POWER COMPANY,

Chicago, Ill., capital stock $50,000, has been formed to supply light, heat and power, etc. F. L. Goulding, L. J. Mosness and A. F. Wright are the promoters.

THE NEWBURGH ELECTRIC RAILWAY COMPANY, Newburgh, N. Y., capital stock $150,000, has been formed to operate an electric railroad. H. C. Norton, B. B. Odell, Jr., and William D. Dickey, Newburgh, N. Y., are the organizers.

THE EASTERN ELECTRIC LIGHT, HEAT AND POWER COMPANY, Southampton, N. Y., capital stock $15,000, has been formed to supply light, heat and power. J. H. Adams, 41 West 27th street, and R. B. Roosevelt, Jr., 26 West 52d street, New York, and F. S. Tainter, Southampton, N. Y., are the promoters.

THE NORTH SIDE ELECTRIC STREET RAILWAY COMPANY, Chicago, Ill., capital stock $500,000, has been formed to construct and maintain a system of street railways in Chicago. F. W. McNallu, William Kilpatrick and August Rieke are the interested parties.

THE BEAVER MEADOW, TRESCKOW AND NEW BOSTON RAILROAD COMPANY, Hazleton, Pa., capital stock $200,000, has been formed to construct and operate an electric railway. A. S. Van Wickle, A. M. Eby and C. J. Kirschner are the interested parties.

THE NORTHWEST FIXTURE COMPANY, Seattle, Wash., capital stock $12,000, has been formed to manufacture and sell electrical apparatus and do a general merchandise business, etc. A. L. Kasson, J. G. Hawkins, C. Swawburg, N. W. Huggins and A. I. Stretcher are the promoters.

THE ELECTRIC POWER AND MACHINERY COMPANY, Jersey City, N. J., capital stock $100,000, has been formed to manufacture and sell, etc., machinery pertaining to the utilization of electricity. The promoters are F. Mansfield, Jersey City, N. J.; C. P. Breese and J. L. Ludwig, New York.

THE ATCHISON TELEPHONE AND ELECTRIC LIGHT COMPANY, Atchison, Kan., capital stock $50,000, has been formed to construct and maintain a telephone line and to erect an electric light plant. B. P. Waggoner, W. P. Waggoner, David Kelso and Ellsworth Ingall, all of Atchison, are the incorporators.

THE ELECTRIC INSPECTION AND REPAIR COMPANY, New York, capital stock $15,000, has been formed to manufacture and construct, inspect and repair electrical apparatus. L. H. Starke, 210 East 113th street; J. J. McConnell, 47 Broome street, and F. C. Cannon, 848 Broadway, New York, are the incorporators.

THE SOUTH CALIFORNIA PRINTING TELEGRAPH COMPANY, Los Angeles, Cal., capital stock $1,000,000, has been organized to build and operate telegraph lines, make, transmit and deal in electricity for light, heat and power. F. P. Flint, H. Lindley, J. J. Muir, W. F. Parker and J. C. Kays, Los Angeles, are interested.

THE ELECTRIC ILLUMINATING AND POWER COMPANY OF LONG ISLAND CITY, Long Island City, N. Y., capital stock $50,000, has been organized to supply light, heat and power. E. A. Maher, 212 Lenox avenue, New York; C. Meyer, Maspeth, L. I., and D. H. Valentine, 16 Court street, Brooklyn, N. Y., are the organizers.

THE ELECTRICAL MANUFACTURING COMPANY OF AMERICA, Red Bank, N. J., capital stock $300,000, has been formed to manufacture and construct electrical and mechanical apparatus of any description. W. J. Keys, Somerville, N. J.; W. L. Corliss, T. Davis, J. F. Bray, Red Bank, N. J., and U. T. Fackenthall, Brooklyn, N. Y., are interested parties.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
41 Park Row NEW YORK, March 2, 1894.

THE MASON ELECTRIC COMPANY is now moving from 1,391 Fulton street, Brooklyn, to 10 and 12 Fifth avenue, Brooklyn, where it will occupy larger quarters.

FREDERICK PEARCE, of 76 John street, is compiling a new catalogue, which will soon be published. It will contain a full list of all electrical specialties, with prices and illustrations. It is expected that the catalogue will be ready by March 15.

BROOKLYN, N. Y.—The department of police and excise in the Municipal Building, Brooklyn, calls for sealed proposals, to be received to March 13, at noon, for furnishing materials and supplies for the telegraph department, as per details, to be had of Leonard R. Wells, commissioner of police and excise.

MR. J. E. HAM, general sales agent for Kerite wires and cables, 203 Broadway, New York, reports that the 300 miles of Kerite cable constructed for the New York Central and Hudson River Railroad Company for signal service between Albany and Buffalo has been in service continuously and without interruption throughout the severe winter. Train dispatches and signal tower service during the recent storms were in no manner interrupted.

MR. U. T. FACKENTHALL, who severed his connection with the Electrical, Mechanical, Engineering and Trading Company, of New York, last January, has now formed the Electrical Manufacturing Company of America, and opened offices in the Havemeyer Building, 26 Cortlandt street, New York. The factory is at Red Bank, N. J. The company proposes manufacturing telephones, magneto bells, blasting machines, fire alarm apparatus, automatic machines and sterilizing apparatus. W. J. Keyes is the president, Eugene Fackenthall, vice president and general manager; Joseph F. Bray, secretary, and Thomas Davis, Jr., treasurer.

MR. WILLIAM B. VANSIZE, the patent attorney and electrical patent expert, has now established independent offices for the practice of his profession at 44 Broad street, New York City. Mr. Vansize has been engaged in electrical work since 1868, and has literally "grown up" with its various branches. He was admitted to the bar in 1879, and has since been continuously and exclusively employed by the great corporations successively organized to develop the telegraph, the telephone, the storage battery, electric light, power, and the electric railway, thus being active in securing many valuable patents and determining many contested patent questions. Now that his extensive experience is at more general disposal his clientage will greatly increase.

THE COMMERCIAL CABLE COMPANY some time ago contracted for a new ocean cable with Siemens & Brothers, of London. It is understood that the contract for the wire, amounting to 1,500 tons, was distributed between three manufacturers, one in England, one in Germany, and the other to John A. Roebling's Sons' Company, Trenton, N. J. Probably the most interesting fact in connection with the transaction is that the copper rods for drawing the wire for the English part of the contract are to be made by the John A. Roebling's Sons' Company, the latter, therefore, making one-third of the entire copper wire required. This company has practically completed its shipment of wire. The lot, taken as a whole, is probably the best lot of wire ever produced. None was passed at less than 99 per cent. of Dr. Matthiessen's standard. The average of all tests was 99.4 per cent. Only 104 pieces of wire were thrown out, and, with one exception, they were above 98 per cent., while the aggregate of all the wire actually shipped was 99.873 per cent.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., March 3, 1894.

MAYOR MATTHEWS has vetoed the order passed by the aldermen of Boston requiring the consent of the board to all street openings for laying and repairing electric wires and conduits in the city. He thinks such power should remain with the executive.

THE W. S. HILL ELECTRIC COMPANY, of Boston, came very near being burned out this week, or in any event sustaining serious loss and inconvenience to its rapidly growing business. Fire broke out early last Monday morning in one of their stock rooms, containing mostly files of documents and office stationery supplies, but before gaining much headway it was fortunately discovered.

THE COLUMBIA ELECTRIC COMPANY, of Worcester, recently did some very quick work in the wiring of the exhibition booths and installation of incandescent lamps in connection with the Food and Health Exposition, now in progress in that city. It accepted the contract on a Saturday and completed the installation by Monday morning at the opening of the exposition, and a very pretty installation it is. The company occupies an exhibit booth, and its display of electrical apparatus and supplies, all of which are tastefully ornamented with an assortment of colored lamps and shades, attracts universal attention.

LINTON & SOUTHWICK, of Worcester, Mass., report business as unusually good with them in their particular line of electrical work. During the past year they have more than trebled their capacity, and have introduced several new features in the line of switches, of which they make a specialty. Both of these gentlemen possess valuable practical knowledge incident to central station requirements, are energetic and pushing, and those who know them well predict for them continued excellent business and a prosperous future. They claim for their switches that they are the best, cheapest, reliable and quick, qualities readily appreciated by electric light and railway plants. Certainly they are kept busy manufacturing them.

THE PETTINGILL-ANDREWS COMPANY, of Boston, has decided to enter the electric railway field more actively, and to that end has engaged the valuable services of Mr. Frank S. Cicott as manager of its railway department, who, as an electrical engineer, enjoys an enviable reputation. Mr. Cicott was formerly the Pacific Coast agent (resident) at San Francisco for Holmes, Booth & Haydens, from 1882 to 1889, leaving this firm to accept the management of the railway department of the Electric Merchandise Company, of Chicago, Ill. In 1891 he originated and started a tramway and railway paper in London, England, called the "Railway World," and still continues as a share owner and director in the board of the English publishing company.

Western Notes.

Branch Office of The Electrical World
936 Monadnock Building Chicago, March 2, 1894.

THE WALLACE ELECTRIC COMPANY, of 104 Michigan avenue, has secured several valuable agencies, and is now busy with a new catalogue, which promises to be very handsome. It announces that its purpose is to conduct a business in electrical goods as manufacturers and manufacturers' agents, and not as general electrical supply dealers.

THE CENTRAL ELECTRIC COMPANY'S metal sheathed bushing, recently put on the market, conforming with the underwriters' requirements, has come into immediate popularity, and in explanation of the reason the Central Electric Company says that there is no other article of a similar nature offered to the trade. It is confidently expected that this bushing will take the place of glass, porcelain and vulcanized rubber.

THE ELECTRIC APPLIANCE COMPANY is pleased to announce to its friends and the trade in general that it is now prepared to supply original "Packard" lamps. This lamp will be remembered as a leading incandescent lamp for a great many years during the early days of incandescent lighting. Patent litigation compelled the factory to suspend work for a time, very much to the regret of all station managers who believe in using a high grade article.

MR. M. M. HAYDEN, who during the past seven years has been connected with, and of late years acting in the capacity of president and manager of the Law Battery Company, New York, has resigned his position as such, and will take charge of the Hayden-Booker Manufacturing Company at St. Louis, Mo. This company, a new one, purposes to manufacture and supply the trade with whatever they may require in the galvanic cell line, including the manufacture of glass jars, bushings, covers and zincs, something not done at present by any of the companies who are exploiting cells. Mr. Hayden is known throughout the electrical fraternity as a conscientious worker. The address of the Hayden-Booker Manufacturing Company is 2,140 De Kalb street, St. Louis.

THE JENNEY ELECTRIC MOTOR COMPANY reports through its Western office the following sales for the past two weeks: Two 30-kw., 110-volt dynamos for Chicago; 2 40-kw., 110-volt dynamos, same destination; 2 60-kw., 500-volt generators, Chicago; 2 30-kw., 110-volt dynamos for Washington, D. C.; 2 12-h. p., 110-volt motors, same; 1 25-h. p., 110-volt motor, for Michigan; 1 20-h. p., 110-volt motor, San Francisco; 1 30-kw., 110-volt dynamo, Missouri; 1 30-kw., 110-volt dynamo, Kentucky, and 1 50-h. p., 500-volt motor for Rochester, N. Y. The business of this enterprising house in other sections of the country is equally good, but their Chicago manager, Mr. A. H. Goode, has a way of securing orders that is interesting.

FISHER & PORTER is the name of another firm now attracting attention in Western electrical circles. With offices at 1,025 Monadnock Block, Chicago, they will hereafter carry on a contracting engineering business in the line of complete equipment of steam plants, giving special attention to large work. They have been made Western representatives of the Providence Steam Engine Company, sole builders of the "improved Green engine," and of the Altoona Manufacturing Company, builders of the "H. A. Green engine." Handling engines of the highest grade, of both slow and high speed types, they are prepared to meet any demand for first-class work in this direction. They are making arrangements with other Eastern manufacturers as agents, and expect to be ready in other lines to take advantage of the incoming tide of business, of which they already see indications. Mr. H. F. J. Porter, who was first assistant mechanical engineer at the late Exposition during the period of construction, and afterward assistant chief of the machinery department, will bring into the firm a great deal of practical information, as well as a most thorough knowledge of steam engineering. Mr. Albert Fisher, the other member, has had a wide experience in the handling of steam engines, having at different times represented in Chicago the "Ball," "Watertown" and "Green" engines.

News of the Week.

Electric Light and Power.

MONETT, MO.—Bids are advertised for an electric lighting plant.

OAKLAND, IND.—A movement is being pressed to establish an electric light plant.

SPRINGFIELD, S. D.—The town of Springfield, S. D., has decided to put in electric lights.

MT. STERLING, ILL.—C. E. Brockman is in the market for a complete lighting plant.

LEAVENWORTH, KAN.—The matter of a municipal electric light plant is being agitated.

FLANAGAN, ILL.—A committee has been appointed to investigate the cost of electric lights.

NORWICH, CONN.—Solomon Lucas, of Norwich, is interested in the proposed electric road to Westerly.

GAINESVILLE, TEX.—Bids have been called for the construction of the new electric light company's plant.

LEAVENWORTH, KAN.—The citizens will vote in April in the matter of issuing $30,000 in bonds for an electric lighting plant.

NEWTON, N. J.—The matter of waterworks and electric lights for Newton will come up at the town meeting on March 13.

PITTSBURGH, PA.—The Allegheny County Electric Light Company proposes to extend its wires to the Hazlewood district.

NEOSHO, MO.—An election will be held April 17 to vote in the matter of issuing $12,000 in bonds for an electric light plant.

DENVER, COL.—The county commissioners are considering the matter of placing an electric light plant in the court house.

AMBLER, PA.—The proposition to issue bonds to the amount of $15,000 for an electric lighting plant was defeated by nine votes.

MURPHYSBORO, ILL.—The city authorities are negotiating for the purchase of the electric light plant recently established in that city.

WILLIAMSPORT, PA.—Arrangements are now under way for the improvement of the old electric light plant for lighting the streets with electric arc lights.

SPRINGFIELD, MASS.—The committee on lighting streets has voted to award a contract to the United Electric Light Company for a five-year term.

CHARLOTTE, N. Y.—Citizens of Charlotte are discussing the matter of waterworks and electric lighting. A syndicate, represented by Michael Doyle, has offered to build the same.

BLACK ROCK, N. Y.—The Board of Public Works has been authorized to expend not more than $350 in purchasing apparatus for testing gas and electricity.

SPRINGVILLE, N. Y.—Assemblyman Schoepflin has introduced a bill to authorize the village trustees of Springville to erect and operate an electric lighting plant.

TERRA ALTA, W. VA.—A committee of citizens has been appointed to ascertain how many will take electric lighting if a company is formed and a plant erected.

BROOKLYN, N. Y.—The roundhouse and repair shops of the Union Elevated Railway in Brooklyn, between Alabama and Vesta avenues, were burned. Loss, $20,000.

RICHMOND, VA.—A bill has passed the Senate incorporating the Chesterfield Transit Company to build an electric railway from Richmond and Manchester to Petersburg.

The Electric Railway.

LOCKPORT, N. Y.—William T. Ranson, of Lockport, states that the proposed Lockport and Olcott electric road will surely be built this summer.

SUNBURY, PA.—It is stated that an electric road will be built this summer from Sunbury to Selinsgrove, but no names have yet been mentioned.

GLOVERSVILLE, N. Y.—Fire has gutted the main building of the Cayadutta Electric Railroad Company on South Main street. The loss will reach $10,000.

CINCINNATI, OHIO.—The Madisonville and Cincinnati Street Railway Company has applied for a franchise over Columbian, Bramble and Central avenues.

HARRISBURG, PA.—The Beaver Meadow, Tresckow and New Boston Railway has been incorporated to build a railway in Carbon, Luzerne and Schuylkill counties.

TOLEDO, OHIO.—It is stated that surveys will be made this week for the proposed electric road from Toledo to Detroit. J. A. Dowson is promoter of the company.

MIDDLETOWN, CONN.—The selectmen have been petitioned by the Middletown Horse Railroad Company to grant permission to extend its tracks for an electric road.

MIDDLETOWN, N. Y.—The petition of the Middletown and Goshen Traction Company for right of way through Goshen will be heard at Goshen court house on March 8, at 7:30 P. M.

SYRACUSE, N. Y.—Directors of the Syracuse Street Railroad Company are making plans for their proposed extensions and contracts will soon be given out. W. R. Kimball will give details.

PAULSBORO, N. J.—The meeting in the matter of the proposed extension of the line of the Camden, Gloucester and Woodbury Electric Railway to Paulsboro, has been postponed to March 3.

MEMPHIS, TENN.—The Citizens' Street Railway Company has assumed control of the East End Dummy line, and will substitute electricity as a motive power. General Luke E. Wright is vice president.

FALL RIVER, MASS.—Frank W. Brightman, of Fall River, was elected president, and Robert S. Goff, of Fall River, is clerk of the

Westport and Dartmouth Electric Railway Company, and work will soon be begun.

Personal Notes.

THE WILLIAM LANG COMPANY, of Brooklyn, N. Y., has been fortunate in securing the services of such able gentlemen as Messrs. E. F. Gennert, F. W. Belmont and J. F. Cunningham, who have resigned their positions with the E. P. Gleason Manufacturing Company and accepted the management of the William Lang Company. Mr. Gennert was second vice president of the E. P. Gleason Company, and during the twenty-two years of service with that firm has invented and perfected many gas appliances. When the electric light first appeared as a competitor of gas he devoted his attention to that line of work, and, with the assistance of Mr. Cunningham, the electric light department of the E. P. Gleason Company was established. In the first years of electric lighting this firm was almost alone as manufacturers of a number of electric light fittings, most of which were due to these gentlemen, and the older electricians will therefore welcome them as friends, while the younger members of the fraternity will value none the less their extended experience. The abilities of these gentlemen being so well recognized in electrical circles, their intention to produce a full line of staple electrical appliances, for which, besides, the factory of the William Lang Company is splendidly equipped, will meet with hearty support and the best wishes for their success. Mr. Belmont's ability as a financier is well known, and he will occupy the position of treasurer. Mr. Gennert will be vice president and Mr. Cunningham secretary. Mr. T. E. Conklin will serve as president.

E. F. GENNERT.

F. W. BELMONT.

J. F. CUNNINGHAM.

Miscellaneous Notes.

MR. PENNOCK'S SLICK METHOD.—The following advertisement, signed by the Pennock Electric Company, recently appeared in a St. Louis paper: "Agents wanted everywhere to introduce an electric light that competes with gas at 5 cents per 1,000 feet. Applicants MUST ADVANCE $1,000 for exhibition plant of 100 lights. Salary $25 per week.

THE NEW ORLEANS ELECTRIC SOCIETY, at its second meeting on the evening of Feb. 21, was favored with an address from Mr. Charles H. Rockwell, secretary and treasurer of the Buckeye Electric Company, of Cleveland, Ohio, on the "Present Status of the Incandescent Lamp Litigation." At the next meeting, on March 2, Secretary H. Malochee will read a paper on "The Return Circuit for Electric Roads."

UNIVERSITY EXTENSION COURSE.—A class is about to be formed in mathematics for the New York electrical workers. Mr. Max Osterberg, of Columbia College, who has laid out a plan of instruction, will be in charge of the course. He intends to introduce the subject, commencing with arithmetic and gradually lead up to algebra and geometry, giving as much as is necessary for an electrician to know, in order that he may deal intelligently with the problems that present themselves to him almost daily in connection with wiring and other electrical work. The formation of this class is due to the desire of many attending the course of lectures on practical electricity delivered at Cooper Union to become better acquainted with the phenomena of electrical science.

Trade and Industrial Notes

MR. FRANK H. STEWART, late of the firm of O. D. Pearce & Co., of Philadelphia, has been appointed agent for the Waterhouse arc lamp, Perkins switches and other specialties.

THE WALKER MANUFACTURING COMPANY, Cleveland, Ohio, is now busily engaged in getting out its first street railway generators and motors, and will soon announce the details of its system.

E. S. GREELEY & CO., 7 Dey street, New York, are sanguine as to the prospects in the near future for electrical business in general. Their own business has improved wonderfully recently, and at present the factory is behind on orders, while the Dey street storerooms are a scene of old-time activity.

THE STANDARD TURNING WORKS, Cambridgeport, Mass., although working only in wood, has a considerable trade with electrical manufacturing companies, and calls the attention of those who have not communicated with them that they have special facilities for turning out the highest class of turned work, such as switch handles, etc.

C. H. BARROWS, Willimantic, Conn., has issued a pamphlet describing his system of electric transit. The system of Mr. Barrows is for elevated tracks, and the inventor claims that by means of it electric carriages may be run at 20 miles per hour with 1,000 pounds of battery cells and a pair of 2-h. p. motors, transporting passengers, mails and light freight.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, Hartford, Conn., has leased the entire property and plant of Messrs. Waterhouse, Gamble & Co., and will continue the manufacture of the Waterhouse arc lamp, maintaining its previous excellent character and quality, and is now ready to fill orders for arc lamps for incandescent circuits.

THE F. E. BELDEN MICA MINING COMPANY sent out a unique invitation, printed on sheets of mica, inviting attendance at the dedication of its new mill at Rumney, N. H., on Friday evening, March 2, 1894, from 8 to 12:30. We regret that our duties in connection with the N. E. L. A. caused this tardiness in acknowledging the receipt of the invitation kindly sent to this office.

THOMAS C. WARLEY & CO., 11 South street, Philadelphia, exhibited samples of boiler scale in the red parlor of the Ebbitt House during the convention which were ample evidences of the efficacy of their boiler cleansing compound as a remover of scale, and many were the exclamations of surprise at such amazing results. Messrs. Warley & Co.'s neat circular was pocketed by many for future use.

T. E. CROSSMAN, the accomplished official stenographer of the American Street Railway, National Electric Light and American Waterworks associations, has located in the Franklin Trust Building, 166 Montague street, Brooklyn, where he is prepared to do stenographic work of all kinds. Mr. Crossman is a most thoroughly competent stenographer, as we have had opportunities of learning from the work done for The Electrical World during the last five years.

E. P. ROBERTS & CO. are preparing specifications for dynamo, wiring and fixtures for the Pilgrim Church, Cleveland, Ohio. About 750 lights will be used; a 500-light dynamo and an engine of about 65 h. p. to drive, in addition to the dynamo, a fan for the indirect heating system and for ventilation. The church is large, and has a very elaborate arrangement of Sunday-school rooms, and not only of parlors, dining rooms and kitchen, but also a gymnasium, bath, etc.

THE BELKNAP MOTOR COMPANY, Portland, Me., is meeting with much success with its woven wire commutator brush. The same company will soon enter into the manufacture of machines of 100 to 150 h. p. for railway generator work, and also of multiphase alternating machines. It contemplates a large extension of its works in the near future in order to do this work, as up to the present only direct current machines have been built, and none larger than 60 h. p.

THE CONSOLIDATED ELECTRIC STORAGE COMPANY, in a communication sent us in answer to a recent one published in these columns from the Electric Storage Company, denies that it has circulated objectionable matter in regard to the chloride battery, except giving in several instances the usual notice of infringement, as it is bound to do in order to secure a status in the courts. The letter further upholds the claim that the Brush patent covers the chloride battery.

THE HINE & ROBERTSON COMPANY, 57 Cortlandt street, New York, is sending its two handsome indicators to all sections in the United States and quite a number of foreign countries. It would surprise many to see some of the indicator cards taken before and after the valves of an engine have been adjusted by the use of an indicator. In many cases the change represents an economy of fully 25 per cent. in horse power and a cor-

responding economy in fuel. They are certainly great dividend earners.

MESSRS. CHARLES A. SCHIEREN & CO. have received the following letter from the president of the Union Ice Company, to whom they furnished belts last summer: "The two double perforated electric leather belts I purchased of you last summer for the Union Ice Company factory, Mentone, San Bernardino County, Cal., are doing splendidly. The 20-inch belt on a 26-inch motor pulley has a velocity of about 5,000 feet per minute. The 30-inch belt has a velocity of about 3,000 feet per minute. Each transmits 1,500 h. p., and are as perfect as when first put on."

THE GENERAL ELECTRIC COMPANY reports that business is extremely good, in spite of the hard times. At its Schenectady works its railway department is working full blast to turn out the numerous large orders recently received for General Electric 800 motors and multipolar generators. The fitting and appliance department, as well as its wire departments, are also full of busy workers, while the business in lighting apparatus is steadily on the increase. At Lynn the arc lamp and meter departments are more than busy with the newly developed apparatus. The Harrison lamp works report that it is thousands of lamps behind on its orders, even with its extensive facilities.

ELISHA B. SEELEY & CO., of Philadelphia, sole agents for clock systems for night watchmen and employees, reports business in general very good, and exceedingly so in employees' time recorders, of which this company make a specialty. These time recorders are being adopted with increasing rapidity by very many of the manufacturing interests of this country, and so great has been the demand for them that the manufacturers were compelled to increase their facilities in order to fill orders more promptly. These recorders are placed on trial, subject to approval. This company is also agent for the Eco magneto watchman's clock and the Warner electric time system.

THE BACKUS MANUFACTURING COMPANY, of Newark, N. J., has placed upon the market an electric fan, which is made in two styles, ceiling and column, and can be used on 110, 220 or 500 volts, and also on arc circuits. A special feature of the fan is its blade adjuster, which can be changed to any angle while the fan is in motion. This company, to better facilitate the manufacture of its products, has hecently moved into its new factory, 174-182 Pennsylvania avenue. The building, built of brick, is two stories high, and 60x100 feet; it is equipped with the latest improved machinery and tools, and operated by a gas engine of the company's own manufacture. The specialties of the Backus Manufacturing Company are fans, motors, ventilators and gas engines.

THE ELECTRICAL AND MECHANICAL ENGINEERING AND TRADING COMPANY, 44 Broad street, New York, is sending a circular to the trade which describes its electrical railroad system with a complete metallic circuit fully utilizing the track to its maximum conductive capacity, and it claims that this system absolutely stops electrolysis of gas and water pipes, reduces drop of potential and raises the entire electrical railroad system to higher operative economy. In this circular is a photographic reproduction of a section of six-inch water main, showing the rapid electrolytic action of a railway current on underground pipes. Mr. J. H. Vail, the president and chief engineer of the company, was present at the National Electric Light Convention, where he read a paper on this subject.

MR. EDWARD M. BENTLEY, formerly the inventor and engineer of the Bentley-Knight Electric Railway Company, who has been for the past four years and a half in charge of the patent department of the Thomson-Houston Electric Company and the General Electric Company, will sever his connection with the latter company on March 1, and open an office at 40 Water street, Boston, taking up the work of expert in patent cases and solicitor of patents. The law firm of Bentley & Blodgett, with which Mr. Bentley, who is a member of the bar as well as an expert, has been connected, will be dissolved, and his former partner, Mr. G. R. Blodgett, will succeed him as head of the patent department of the General Electric Company, making his headquarters at Schenectady.

THE HORNBERGER ELECTRIC AND MANUFACTURING COMPANY, Elkhardt, Ind., has received the following flattering letter from the Helios company, of Philadelphia: "In reply to your communication, we beg to inform you that we have very carefully tested your new transformer, and the result of our tests convinces us that your transformer is equal in every way to the guarantees you have made us. We find our arc and incandescent lamps can be operated on it at the same time without change in the electromotive force, and there is apparently no change. We also find that it works satisfactorily either with one arc lamp or full load incandescent lamps, or with one incandescent lamp with full load of arc lamps. We believe this transformer solves the problem of maintaining two different potentials from the same transformer; in other words, running arc and incandescent lights from one transformer. If you desire to refer to us at any time, we shall be pleased to serve you."

WARREN WEBSTER & CO., with works at Camden, N. J., and Chicago office at No. 2 Canal street, Chicago, Ill., report among the many orders received for their Webster vacuum feed water heater and purifiers one from the Pullman Palace Car Company, Pullman, Ill., for three more Webster vacuum feed water heaters and purifiers, aggregating over 5,000 h. p., to equip their entire works; also for the Williams vacuum system of steam heating, so as to utilize their waste exhaust steam without back pressure upon engines for heating purposes. Past orders formerly received from this company amounted to 2,700 h. p., and were installed in their plant at Pullman, Ill., during the past four years. Warren Webster & Co. claim to have the best methods for correcting feed water for boilers and for utilizing exhaust steam for heating purposes without back pressure upon engines, giving the best results upon all points of economy. They built their present new works at Camden, N. J., last year, and are now commencing an extension of 60 by 65 feet in their wrought iron department.

ARC LIGHT, TROLLEY AND ARMOR CORD.—Braided cord has now become the standard for the suspension of arc lamps, and it is no less in demand for street car trolley cord and armor cord for covering field magnets of dynamos. The size most frequently used for hanging arc lamps is No. 12 (3/8 inch in diameter); for trolley cord, No. 8 (1/4 inch in diameter); for armor cord, No. 4 (1/8 inch in diameter). Waterproof finish is always applied to arc lamp cord and trolley cord unless otherwise ordered. The Samson Cordage Company, 115 Congress street, Boston, has long been noted for its celebrated "Samson" cord for the above purposes, and also furnishes its "Samson spot cord," which is the same quality and price as the plain "Samson" cord, but marked with a succession of spots of a different color from the body of the cord. This device is for the purpose of identifying at sight the first quality of cord. There is now on the market a quantity of low grade braided cord, which does not possess the strength or durability which is requisite for these purposes. All Samson cord is warranted of pure stock, perfect braid and to be entirely free from waste stock, and purchasers may have confidence that the spot is a guarantee of quality.

THE NATIONAL WATER TUBE BOILER COMPANY, of New Brunswick, in referring to the low bid on which it secured the contract for 1,800 h. p. of boilers from the city of St. Louis—nearly 20 per cent. lower than the next lowest bid and over 40 per cent. below the highest—calls attention to a significant clause in the contract. The specifications of the commissioners provided for a premium of $250 on each of the six boilers for every one per cent. of efficiency actually reached by the boilers above a given per cent., with the same amount of forfeit for each one per cent. below. The condition was introduced for the express purpose of obliging each bidder to guarantee the economy of the proposed boilers, with a substantial money backing, the commissioners being the gainers, even though the premium should be large, as the higher the premium earned the greater the saving in the use of the boilers. The National company was the only one to make a considerable reduction in the contract price, with the expectation of making up the reduction by the large premium to be received in consequence of the great efficiency of their boilers. The conditions of the specifications of the commissioners were novel and shrewdly contrived to call out the relative degrees of confidence which the several makers have in their boilers, and the result of the tests to determine the amount of premium to be paid will be of unusual interest.

MESSRS. QUEEN & CO., incorporated, of Philadelphia, attracted great attention at the convention with their display of "Acme" hot wire voltmeters, portable, switchboard and recording types, as also "Acme" portable testing sets, cable testing apparatus, etc. The "Acme" voltmeters are extremely compact and well made. They are accurate alike for alternating and direct circuits, and are dead beat, without the use of a mechanical brake, this latter feature being possessed by no other standard alternating current voltmeter. A neatly prepared price list was distributed, which gave full particulars as to ranges, styles of mounting and prices. Instruments are supplied with single or double scales and with multipliers of any desired capacity up to 3,000 volts. Next to refined accuracy, the most important fact about the "Acme" voltmeters is the remarkably low prices at which they are offered, thus making it possible for every plant, however small, to have a strictly reliable testing instrument. The "Acme" portable testing set, samples of which were displayed, contains a Wheatstone bridge, rheostat, D'Arsonval galvanometer and silver chloride battery—all in a highly finished mahogany case 8¼ inches by 5½ inches by 5 inches. It has a capacity of several megohms, and in addition to insulation tests is well suited to determining the resistance of dynamos, motors, lamp filaments and for general laboratory measurements.

THE WOODBRIDGE & TURNER ENGINEERING COMPANY, "Times" Building, has recently completed a contract of considerable importance for the Union Railroad Company, of Providence, R. I. Previous to the 1st of August the Union Railroad Company had in operation but 12 or 15 miles of electric railway. It now has an extensive system of nearly 100 miles in operation, covering not only the entire city of Providence, but much of the available territory round about it. The work of construction was begun about the 1st of July, and during the summer and autumn over 75 miles of overhead line work was completed ready for operation. About one-half of the line is constructed with iron poles, being mainly of the lattice type, though a considerable number of Walworth poles have also been used. On the remainder of the line, both span and

bracket construction, Georgia pine poles are used throughout. The line construction embodies all the latest and best features in this class of work, the line equipment being furnished in part by A. & J. M. Anderson and in part by the General Electric Company, by whom the entire motor and generating equipment was supplied. The feeder lines are run on the poles, there being over 80 miles of feeder wire on the whole system, mostly 500,000 C. M. wire. The lines radiate in all directions from the central business section of the city, reaching to the towns of Riverside, Rumford, Pawtucket, Centredale, Auburn, Cranston, Olneyville and Lakewood. The work of construction was entirely in the hands of Mr. Elmer Bell, the superintendent of the Woodbridge & Turner Engineering Company, and was pushed vigorously through to completion, so that the whole system was practically ready for operation by the middle of November.

THE PAGE BELTING COMPANY, Concord, N. H., states in regard to the St. Gaudens medal, that two law suits are now pending as a consequence of the controversy over the medal, one by St. Gaudens against the Page Belting Company for alleged damage to the artist, and the other brought by the Page Belting Company against Mr. St. Gaudens for alleged libellous language employed by the latter against the former. The officers of the company have made a further statement to the effect that their president and general manager, George F. Page, secured in October certified copies, duly signed, of the two awards made by the judges of belting at the Columbian Exposition, and that on the 8th of December he went to the mint in Philadelphia and was shown the St. Gaudens model of the proposed medal, which he examined in the presence of the officers of the mint and afterward reproduced it from memory. The awards published are an exact reproduction of the language used by the judges. That the reproduction of the medal is a good one, the statement made by its president, is corroborated by the testimony of Treasury officials and Senators who have compared the published fac-similes and the original medal, The copies of the judges' awards were obtained, it claims, in a proper and legitimate manner. They were intended for publication. It was simply a question of when the first publication should be made. As for the design of the medal, that had been purchased by the United States Government. As exhibitors, two of these medals having been awarded to the Page company, and it claims a right to their use as soon as it could come into possession, in a proper and legitimate way, of either the medal itself or a copy of its design, and that is precisely what it did. The copies have been published for advertising purposes, exactly as was originally intended should be the case, as will be done by other exhibitors at the World's Fair who obtained medals and diplomas, so soon as they shall see fit to make the publications after they come into possession of the wording of the awards and copies of their medals.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED FEB. 20, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

513,145. ELECTRIC SIGNALING BETWEEN RAILWAY TRAINS; J. J. Czepull, Lancaster, Pa. Application filed Aug. 8, 1893. The combination of a bar having contact pins in its opposite ends, conductors connected therewith, a movable contact bar bearing against the pins, and a key secured to the contact bar.

515,179. ELECTRIC RAILWAY CONDUIT; M. S. Towson, Cleveland, Ohio. Application filed Jan. 6, 1893. The combination of a slot rail and a conductor suspended therefrom by fastenings passing through the foot of the rail.

515,192. MATERIAL FOR INSULATING ELECTRIC WIRES; G. A. Cannot, London, England. Application filed Sept. 22, 1893. This consists of a coating of bitumen, peat fibre, spermaceti and tar.

515,205. ELECTRIC ARC LAMP; B. Ford, Johnstown, Pa. Application filed Dec. 8, 1892. This comprises a solenoid regulator, lever, friction spring, carbon, a tube to keep the carbon aligned and a magnet to actuate and release the carbon.

515,216. DYNAMO OR ELECTRIC MOTOR; L. Gutmann, Pittsburgh, Pa. Application filed Feb. 13, 1892. The combination with one or more stationary field magnets, one or more rotating armatures and a distance piece mounted on either or both machine elements.

515,238. TROLLEY CONDUCTOR AND SUPPORT; M. D. Law, Washington, D. C. Application filed Aug. 29, 1893. A conductor comprising rails of L shape in cross-section having supporting webs and contact flanges, the webs and flanges being overlapped at the meeting ends of the rails.

515,241. RHEOSTAT; J. B. Lyon, Brooklyn, N. Y. Application filed Dec. 22, 1891. A rheostat consisting of the combination of a resistance medium and a pair of electrodes geared together and movable with respect to each other.

515,254. RHEOSTAT; A. J. Shaw, Muskegon, Mich. Application filed Oct. 13, 1893. A resistance device consisting of an open frame and a wire band wound around the frame and connected at one end therewith, but insulated therefrom at all other points.

515,255. ELECTRIC ELEVATOR BRAKE; A. J. Shaw, Muskegon, Mich. Application filed Oct. 24, 1893. This comprises an electric motor, a brake, an electromagnet for controlling the brake, and means whereby the reversal of the motor is caused to vary the strength of the brake controlling magnet independently of the strength of the current delivered to the motor.

515,256. ELECTRIC ELEVATOR BRAKE; A. J. Shaw, Muskegon, Mich. Application filed Nov. 4, 1893. In combination with a motor and brake, a differential electromagnet for controlling the brake, and means for controlling the flow of current through the windings of the differential magnet.

515,274. INDICATOR FOR ELECTRIC CARS; H. C. Beckmann, St. Louis, Mo. Application filed Aug. 17, 1893. The combination of a fixed conductor with a swinging contact rod and an indicator carried by the car, electrically connected with a projecting rigid contact rod moving with the car.

515,280. RHEOSTAT; G. A. Brown, Muskegon, Mich. Application filed Aug. 19, 1893. A resistance body consisting of a strip of iron, with the mill scale or oxide upon it, folded back and forth upon itself in compact form.

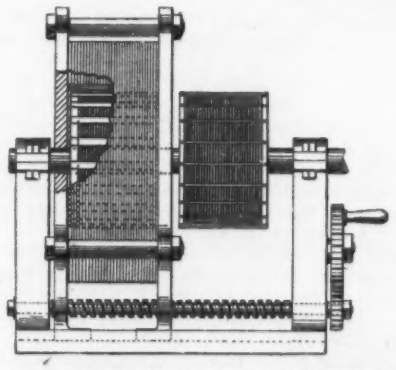
515,281. ELECTRIC ELEVATOR BRAKE; G. A. Brown, Muskegon, Mich. Application filed Oct. 13, 1893. This consists in passing the reversible current of a motor through one winding of a differential brake magnet and through the armature of the motor in series.

515,286. ELECTRIC STEERING GEAR; F. L. Dyer, Washington, D. C. Application filed April 17, 1893. The combination with a steam steering engine of an electrical device for controlling the valves thereof, the electrical device consisting of a plurality of solenoids, the cores of which connect with said valves, and a controller for the solenoids.

515,304. RHEOSTAT; A. J. Shaw, Muskegon, Mich. Application filed Oct. 13, 1893. A resistance body consisting of a conducting band wound into a flat spiral, the folds of the spiral separated one from another by a layer of enamel.

515,308. ELECTRIC RAILWAY TROLLEY; C. J. Van Depoele, Lynn, Mass. Application filed Nov. 8, 1890. A trolley pivoted to a standard on the roof of a car and free to swing around the standard, a spring for pressing the trolley upward and a line connected with the arm above the pivot for moving the arm.

514,902. ALTERNATING CURRENT MOTOR; C. S. Bradley, Avon, N. Y. Application filed Sept. 27, 1892. An alternating current motor having a primary element, two secondary elements, one of high and the other of low resistance, and means for shifting the elements relatively, so that the primary may co-operate with either secondary. (See illustration.)



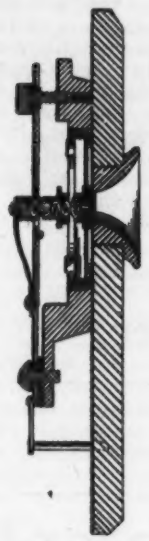
NO. 514,902.—ALTERNATING CURRENT MOTOR.

514,903. ALTERNATING CURRENT ELECTRIC MOTOR; C. S. Bradley, Avon, N. Y. Application filed Sept. 27, 1892. An alternating current motor having one element wound to develop progressively shifting poles, and the other element provided with a closed secondary circuit inductively related to the shifting poles, means for developing opposing electromotive forces in the secondary circuit and a common path of relatively high resistance forming a multiple arc circuit for currents due to the opposed electromotive forces.

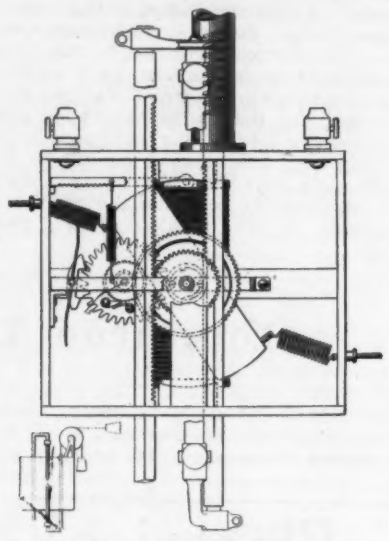
514,904. ALTERNATING CURRENT MOTOR; C. S. Bradley, Avon, N. Y. Application filed Jan. 14, 1893. The combination

with a magnetic core wound to develop a rotary magnetic field and an armature provided with two windings, one having a circuit inductively acted upon by the rotary field and the other a synchronous circuit supplied through a redirecting commutator.

514,907. DYNAMO ELECTRIC MACHINE; C. F. Brush, Cleveland, Ohio. Application filed Jan. 14, 1879. An alternate current generator comprising two series of field magnets, coreless coils or



NO. 514,916.—TELEPHONE.



NO. 515,022.—ARC LAMP.

folds mounted on a diamagnetic carrier, and a shaft having insulating material interposed between its sections.

514,913. CUSHION FOR TELEPHONE RECEIVERS; V. A. Cook, Averill Park, N. Y. Application filed Nov. 28, 1893. This comprises a compressible and elastic cushion, filled with air and a flexible material, a flexible ring attached to the cushion, and a metallic band to secure the ring against the face of the receiver.

514,916. TELEPHONE; D. Drawbaugh, Eberly's Mill, Pa. Application filed July 26, 1880. A diaphragm carrying two electrodes, insulated from each other, in combination with opposing electrodes held in contact with the first mentioned electrodes by an elastic pressure device.

514,920. TELEPHONE TRANSMITTER; P. Fitzsimons, Birmingham, Ala. Application filed June 14, 1893. This comprises a central block of conducting material, similar radial blocks and loosely mounted conducting pencils radiating from the central block to the radial blocks, a portion of the same being in circuit and a portion being idle.

514,925. ELECTRIC CABLE; T. Guilleaume, Mulheim-on-the-Rhine, Germany. Application filed Oct. 6, 1893. This comprises a section of grooved insulating material adapted to receive in its grooves separate conductors, whereby the whole may be twisted into one circular cable.

514,932. TROLLEY WIRE SUPPORT; R. M. Hunter, Philadelphia, Pa. Application filed June 30, 1893. This comprises a trolley wire, a support soldered to the under side thereof, and a transverse supporting wire arranged at or about the level of the trolley wire for sustaining the trolley wire and support.

514,933. TRANSFORMER; F. S. Hunting, Fort Wayne, Ind. Application filed Feb. 25, 1892. This comprises a number of separate cores influenced respectively by currents of different phase and a secondary coil having a portion of its convolutions inclosing each core, the number of convolutions being apportioned according to the desired phase displacement.

514,960. ELECTRIC BELL ALARM; W. H. Orpen, Jr., Brooklyn, N. Y. Application filed April 29, 1891. This comprises a case having a journal box integral therewith, a recess in the back divided from the ringing mechanism by a wall and a partition separating the mechanism.

514,972. ELECTRIC RAILWAY SYSTEM; N. Tesla, New York, N. Y. Application filed Jan. 2, 1892. This comprises an insulated conductor supported in a slotted conduit, an insulated sheath or screen surrounding the conductor, a conducting plate or bar carried by an arm depending from the car into the conduit, and an electrical connection between the plate and the motor on the car.

514,973. ELECTRIC METER; N. Tesla, New York, N. Y. Application filed Dec. 15, 1893. The combination with a circuit of alternating currents of a meter composed of two conductors connected respectively with the circuit and separated by a rarefied gas substance.

514,975. ELECTRICAL ANNUNCIATOR; N. M. Watson, Detroit, Mich. Application filed July 7, 1892. The combination with an electric circuit of a magnet, a pivoted armature, a target actuated by the armature, and a movable spring catch for supporting the target in its visible position.

514,979. BATTERY; D. H. Wilson, Chicago, Ill. Application filed Sept. 8, 1893. In a primary battery, the combination of a zinc and copper plate, with their broad surfaces exposed to each other, their exposed sides deeply corrugated and a solution in which the plates are immersed.

514,980. SWITCHBOARD SYSTEM; D. H. Wilson, Chicago, Ill. Application filed Sept. 8, 1893. A switchboard for an electric fence, consisting of a transmitting and receiving telephone, a lever upon which the receiving telephone is normally hung, conducting plates on the end of the lever, contact points adjacent thereto, a third contact point normally in contact with the lever, a telegraph instrument having a movable base, and connections whereby when the telephone and telegraph instruments are connected to the fence wires the connection of the wires with the generator is automatically broken.

514,981. CIRCUIT MAKING AND BREAKING DEVICE; D. H. Wilson, Chicago, Ill. Application filed Sept. 8, 1893. The combination of an induction coil with a circuit breaker in the primary circuit, the circuit breaker comprising a pivoted plate, to which is fastened a sealed mercury chamber with contact points of unequal length therein, the circuit breaker and induction coil being so related that when the latter is energized the mercury chamber is moved to break the circuit, and an adjustable spring and stop associated with the circuit breaker to regulate the rapidity of its motion.

515,020. ELECTRICAL CONVERTER; A. L. Riker, New York, N. Y. Application filed July 27, 1893. A converter core built up of a series of laminae of substantially the shape of the letter F, the parts being so proportioned that when two of them are placed together they form a conrinuoud rectangular frame, with a strip extending centrally across the same.

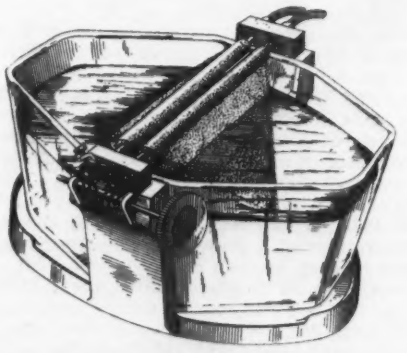
515,022. ELECTRIC ARC LAMP; S. W. Rushmore, Brooklyn, N. Y. Application filed Feb. 20, 1893. This comprenends the use of a single electromagnet in combination with an armature moving upon a central axis under the influence of both poles of the magnet and a short train of gearing mounted in a frame, which is pivoted on an axis coincident with the axis of the armature.

515,087. ELECTRIC DISTRIBUTION BOX; O. D. and M. A. Kleinsteuber, Milwaukee, Wis. Application filed June 27, 1893. A series of contact sections in combination with a common support for the series, an inclosing casing for the same, and two lengths of cables, each containing a plurality of wires leading into the casing and making contact with the respective series of contact sections.

515,108. ELECTRICAL CIRCUIT CONTROLLER; R. Callender, Brantford, Canada. Application filed Nov. 2, 1893. A circuit controller having a series of radially disposed plungers adapted to be moved into electrical connection with a common conductor, in combination with a revolving arm carrying an electromagnet adapted to raise any of said plungers into their uppermost position.

515,109. ELECTRICAL CIRCUIT CONTROLLER; R. Callender, Brantford, Canada. Application filed Nov. 2, 1893. Two or more reed armatures having different periods of natural activity when put into motion by the closure of a circuit through a controlling electromagnet, in combination with means whereby two or more additional circuits are independently closed by the reed armatures at the termination of their individual vibratory period.

515,125. ARC LAMP; W. O. Meissner, Chicago, Ill. Application filed Sept. 11, 1893. The combination of a carbon rod with a clutch having two clamping edges rigidly united in one struc-



NO. 515,241.—RHEOSTAT.

ture and adapted to alternately clutch and move the rod in either direction, and a magnet connected so as to control the clutch.

515,110. AUTOMATIC SIGNALING TRANSMITTER; R. Callender, Brantford, Canada. Application filed Nov. 2, 1893. This comprises a controlling commutator and a rotary circuit making and breaking device, timed to have a definite relative speed of rotation, means for giving the circuit closer any predetermined number of revolutions, and additional means for varying at will the number of circuit closures in each revolution.

515,297. ELECTRIC IGNITER FOR GAS ENGINES; J. Low and J. W. Gow, Steubenville, Ohio. Application filed May 13, 1893. This consists of a magnet having its core projecting into an engine cylinder and insulated therefrom, means for completing the circuit of the magnet, a contact on the piston influenced by the magnet, whereby a spark may be produced when contact is made and broken with the magnet core.